

# Assessment of peritoneal membrane characteristics using segmental abdominal bioimpedance spectroscopy

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## Background and Aims

Ultrafiltration failure is a frequent cause for discontinuation of peritoneal dialysis (PD). The peritoneal equilibration test (PET) is the standard method for assessing characteristics of peritoneal membrane. However, dynamic membrane characteristics and the dynamics of the intra-peritoneal volume (IPV) during the dwell cannot be determined with the standard PET.

Here we explore segmental abdominal bioimpedance spectroscopy (SBIS) as a novel tool to assess intraperitoneal fluid dynamics and peritoneal membrane characteristics.

## Methods

Ten PD patients (7 females, age 59±8.8 years, weight 71.9±12 kg) were studied during a standard 4 hours PET with 2 L 2.5 % glucose solution. IPV was measured continuously during the PET with SBIS (Hydra 4200) (Fig.1)<sup>1</sup>. Changes in IPV ( $\Delta$ IPV) following the infusion of 2 L dialysate into the peritoneal cavity were defined as ultrafiltration volume (UFV) in the presence of  $\Delta$ IPV>0, otherwise as absorption fluid volume (AFV) (Fig.2).

Concentrations of creatinine, glucose and sodium in plasma and dialysate were measured hourly during the dwell. Difference in dialysate volume (DV) between pre and post PD were compared to the  $\Delta$ IPV. Peritoneal membrane transport characteristics were defined as high, high average (H-Ave), low average (L-Ave) and low based on the ratio of dialysate glucose to initial value ( $D_4/D_0$ ) and ratio of dialysate to plasma creatinine (D/P).

## Results

Three, six and one patients were L-ave, H-ave and high transporters, respectively. Estimation of total UFV at 4 hours ( $\Delta$ IPV4) by SBIS correlated with DV ( $R^2=0.33$ ).  $\Delta$ IPV at first hour ( $\Delta$ IPV1) was significantly higher in L-Ave than in H-Ave and high transporters (Table 1).  $\Delta$ IPV1 correlated with glucose  $D_4/D_0$  ( $R^2=0.57$ ) and creatinine  $D_{Cr4}/P_{Cr4}$  ( $R^2=0.57$ ) (Fig.3 and Fig.4). Changes in dialysate sodium concentrations between 1 and 2 hours differed significantly between L-Ave and H-Ave groups.  $\Delta$ IPV4 was correlated with changes in dialysate sodium concentration between 1 and 2 hours of dwell ( $R^2=0.43$ ,  $p<0.05$ ).

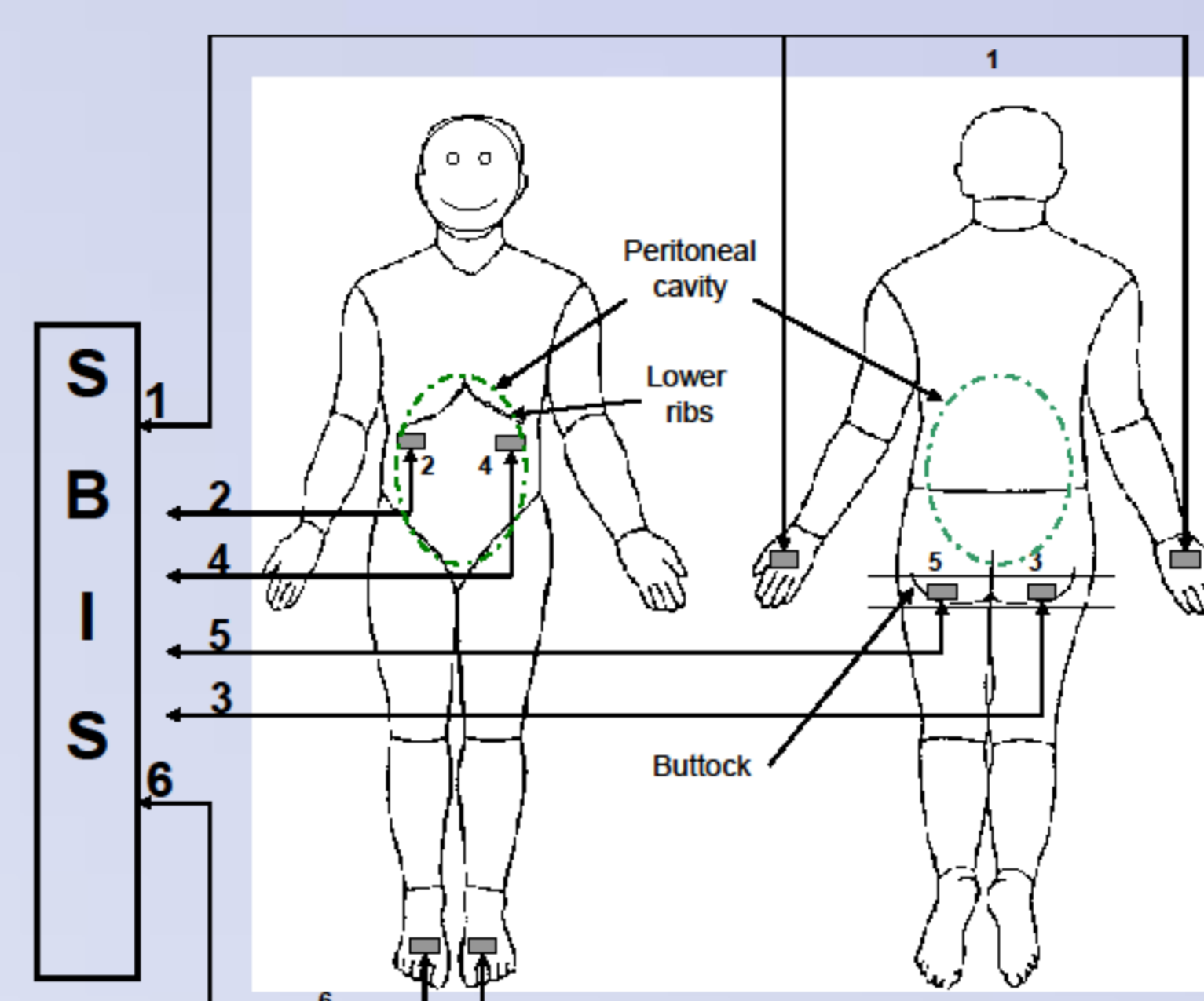


Fig.1 measurement of  $\Delta$ IPV with SBIS

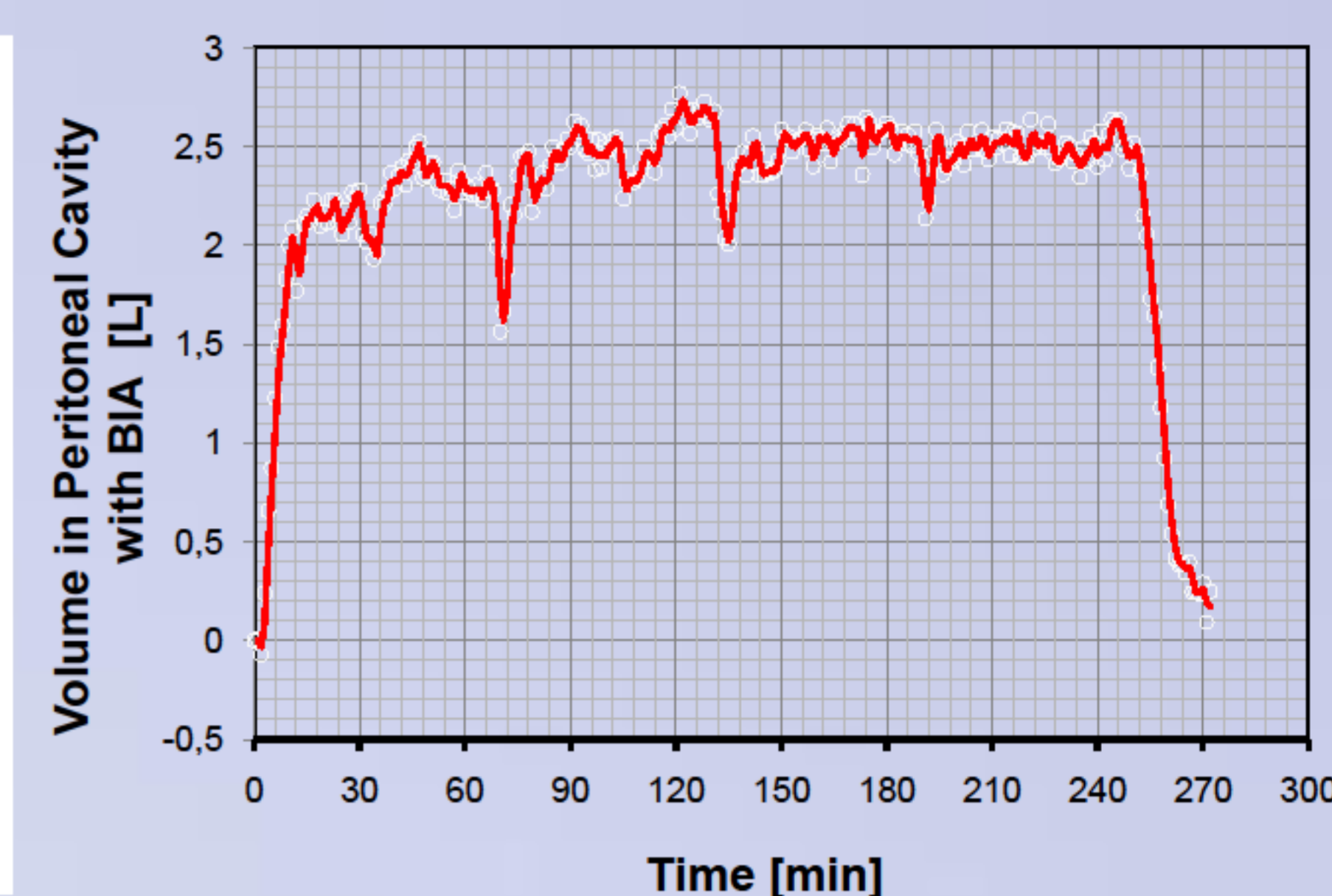


Fig.2 Change in  $\Delta$ IPV during PET

Table 1 Summary of change in IPV in different level of  $D_4/D_0$

$D_4/D_0$	# Pats	$D_{Cr4}/P_{Cr4}$	$D_4/D_0$	$\Delta$ IPV1 L	$\Delta$ IPV2 L	$\Delta$ IPV3 L	$\Delta$ IPV4 L	$\Delta$ Wt kg	Na_Dia2 mg/dL
Low-Ave	3	0.65±0.05	0.4±0.18	0.47±0.2*	0.54±0.5	0.99±0.5	0.67±0.3	0.6±0.2	123±1*
High-Ave	6	0.74±0.06	0.32±0.03	0.07±0.4	0.35±0.1	0.45±0.4	0.42±0.3	0.52±0.3	125.8±1.8
High	1	0.83	0.26	-0.53	-1.1	-0.87	0.01	0	125

\* Significant ( $p<0.05$ ) difference between low-average and high-average groups,  $D_4/D_0$  is the ratio of glucose in dialysate at 4 hours to beginning of dwell.  $D_{Cr4}/P_{Cr4}$  represents ratio of creatinine in dialysate to creatinine in plasma at 4 hours of dwell.

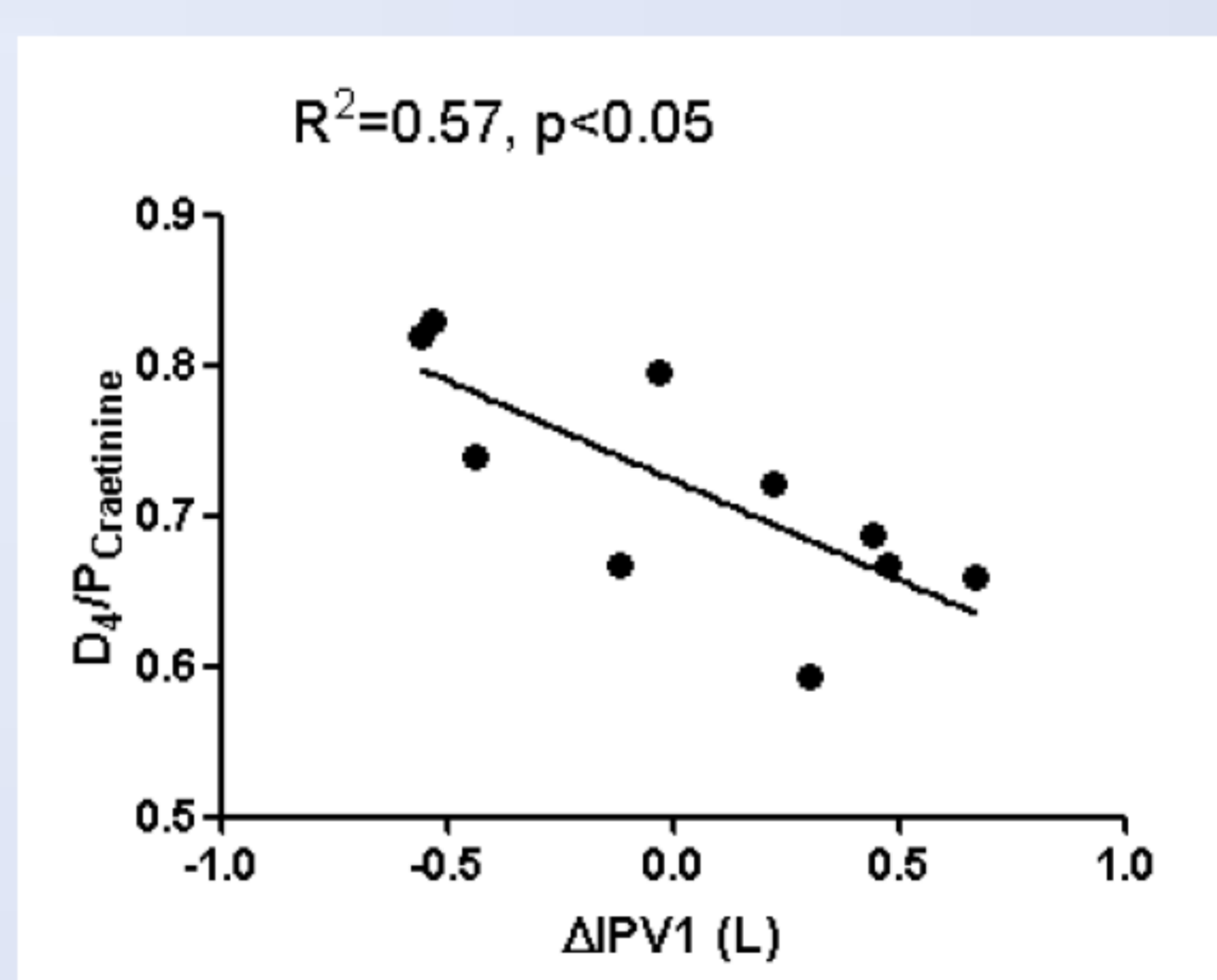


Fig. 3 Correlation between  $D_4/P_4$  and change in IPV during the first hour.

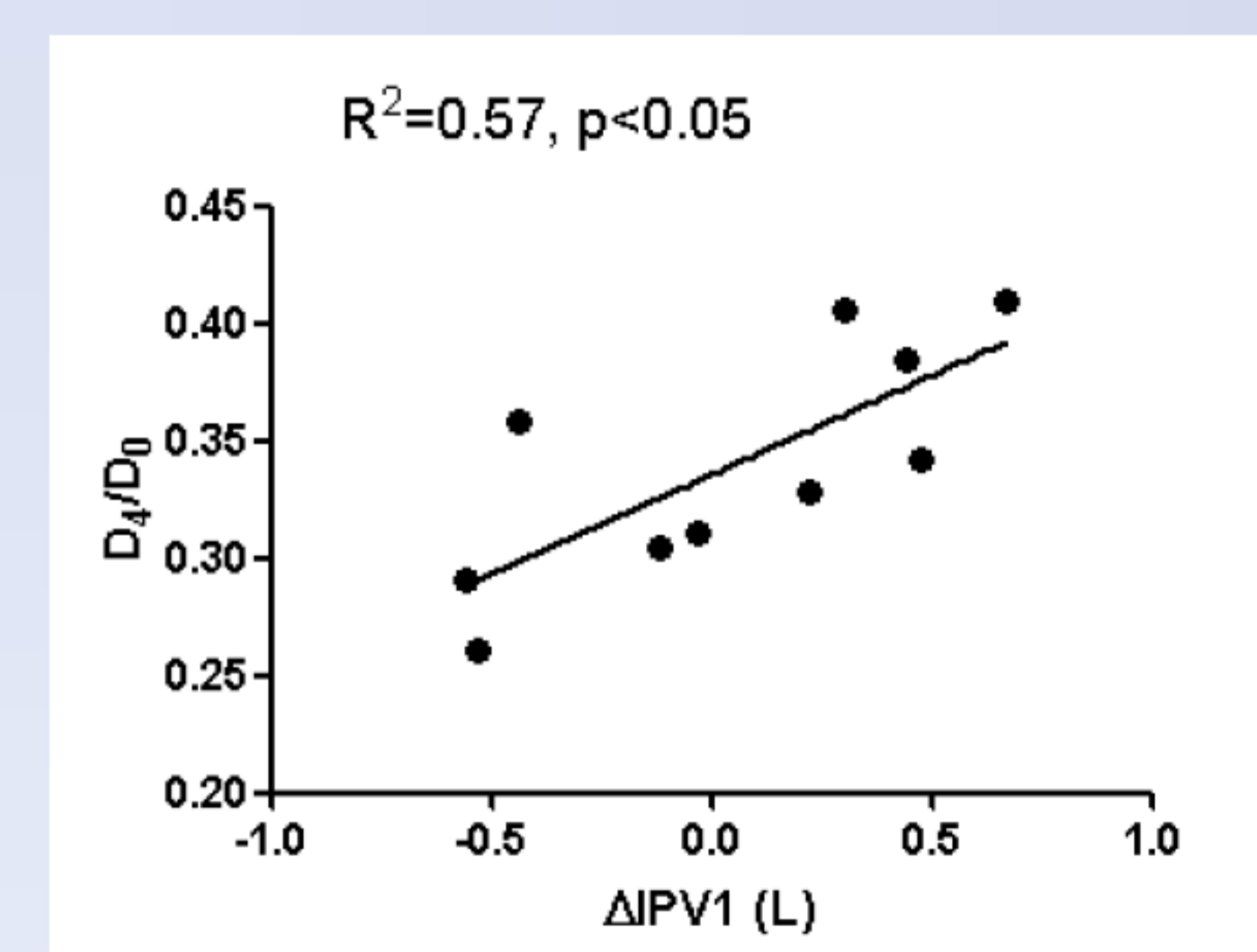


Fig. 4 Correlation between  $D_4/D_0$  and change in IPV during the first hour.

## Conclusion

SBIS is a non-invasive and accurate method capable of directly and instantaneously measuring UFV during PD dwell. This study suggests that  $\Delta$ IPV in the first hour of the dwell may identify the transport characteristics of the peritoneal membrane with respect to fluid volume transport. Lower UFV in the High or H-Ave transport patients may be explained by small change in dialysate sodium in the first 2 hour of dwell due to aquaporin dysfunction. SBIS method could also be useful to identify the time point of maximal UF rate during PD<sup>2</sup>. Further studies are required to explore the clinical value of this method.

## References

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