

Why is it important to regularly test my Peritoneal Membrane?

Evaluation of peritoneal membrane characteristics and prescription management: a position statement of ERBP

INTRODUCTION

The peritoneal membrane is a membrane that lines the abdominal cavity and covers the organs that lie in that cavity. Peritoneal dialysis (PD) uses this as a semi-permeable membrane for dialysis. The properties of the membrane are important in selecting the optimum treatment regimen. Its properties and quality vary among individuals and also within the same individual over time so it is important to regularly evaluate its characteristics in order to determine the most appropriate prescription for each individual patient. The recommendations in this 'position statement' are based on expert opinions, supported by available evidence and suggest how this should be carried out.

THE NEED FOR TESTS OF PERITONEAL CHARACTERISTICS

Frequency: Tests of peritoneal membrane characteristics should be routinely repeated once a year, or when new clinical problems such as over-hydration, malnutrition, or metabolic disturbances are noticed.

The aims of testing peritoneal membrane function are: to optimize a treatment prescription with regard to the removal of 'kidney failure related toxins' of different sizes and fluid volume regulation; and to see how peritoneal membrane function changes over time.

The peritoneal membrane characteristics, specifically the transport rate of toxic solutes and ultra-filtration capacity, are fundamental to PD prescription, and will guide prescription. Based on these differences, a therapy can be tailored to the specific needs of the patient in terms of the ideal duration of different dwells, the number of dwells, and the type of dialysis solution used. An inappropriate prescription can lead to substantial underachievement in terms of the removal of toxic waste products and ultra-filtration, or unnecessary exposure to the high glucose content of dialysis solutions (i.e. heavy bags). For example: using Automated Peritoneal Dialysis with short dwells in slow transporters results in salt retention and hypertension, whilst in patients with a fast transport status, long dwells can be associated with fluid volume overload and hypertension. The peritoneal membrane characteristics of some patients will change as they spend months and years on therapy, usually leading to a decreased ultra-filtration capacity and an increase in the transport rate for small solutes.

Choice and application of test of peritoneal membrane characteristics Although there is insufficient evidence to prefer one test over another to determine a clinical prescription, some tests may give specific information not provided by the classical PET test. Thus the type of test used is dependent on the sort of information required to answer a specific question. Some patients may wish to be aware of what these tests are although most will rely on the expertise of their nephrologist. The following brief summary of what is a complex subject is therefore provided:

The Peritoneal Equilibration Test (PET) is the most widely used test for evaluation of peritoneal membrane characteristics. The original PET used a fixed fill volume of 2 liters of a 2.27% glucose solution over a 4 hour dwell. There is no evidence that using 1.36% or 3.86% glucose instead of 2.27% glucose influences the results. The impact of a preceding overnight dwell with icodextrin has only been evaluated in one small study, so no recommendation can be made in this regard. Although the original PET allows accurate estimation of small solute transport, it does not provide sufficient information to discriminate among causes of ultra-filtration failure. To answer the latter question, it is recommended to use a 3.86% glucose solution during the PET, with determination of the evolution of D/P_{sodium} during the dwell. This test has been named "***modified PET***". It is advocated to use the 1 hour value of D/P_{sodium} to estimate the free water transport. This procedure has been named ***the mini PET***. Whereas the mini PET is short, and gives important information on aquaporin function, it fails to provide estimates of net fluid re-absorption from the peritoneal cavity. Formerly PET results categorized patients as high or low transporters which led to confusion. These terms are no longer appropriate for clinical use and prescription management. The current more relevant terminology that has been adopted is "***fast***", "***average***" and "***slow***" transporters. A useful table in the published ERBP paper on this topic summarizes the properties of these 3 types of patient with recommendations as to the most appropriate PD prescription for each type. When applying tests of peritoneal membrane characteristics, some pitfalls should be considered. These are described in detail in the full version of the ERBP paper.

Peritoneal membrane ultra-filtration failure is defined as a drained volume after a 4 hour dwell of less than 2100ml with a 2.27% glucose solution or one of less than 2400ml with a 3.86% glucose solution respectively. The (theoretical) condition "ultra-filtration failure" should be distinguished from the (clinical) condition "over-hydration". Clinical over-hydration is the net result of the volume balance of the patient, and is influenced not only by peritoneal ultra-filtration capacity but also by other factors, such as residual urine production, and dietary salt and fluid intake.

For optimal PD prescription management, other parameters indirectly related to peritoneal membrane characteristics should be considered. Fuller details of these points are given here as they are particularly relevant to patients who manage their own PD.

The catheter outflow pattern is most important and should be monitored on a regular basis. The catheter drainage profile is an important guide to prescription management, especially in APD patients. It should be recognized that drainage time is in fact non-dialysis time. Most patients have a typical drainage profile, with a steeper flow rate initially and subsequently a slower rate with virtually no flow at the end of drainage. At the end of the dwell, insufficient dialysate is present in the abdominal cavity to allow the transport of toxins. The dialysate outflow pattern should therefore be monitored too avoid this period lasting too long. Too long periods of non-diffusion should be avoided. This can be achieved by keeping the number of dwells low, and by starting refill immediately after the "breakpoint", rather than awaiting complete drainage (this can in most cyclers be done using the "tidal" mode).

Residual renal function, both in regard to solute clearance and fluid output, should be monitored on a regular basis by 24 hour urine collection and calculating the mean of urea and creatinine clearance. Residual renal function is not only a major predictor of outcome, it is also an important factor to take into account when making a prescription. Patients with a rapid declining residual renal function often also have a faster deterioration of their peritoneal membrane. It is strongly discouraged to intentionally leave patients over-hydrated in the hope of preserving residual renal function as it has the opposite effect and results in a faster decline of their residual renal function. Furthermore it is an important driver of cardiovascular mortality. Dehydration should also be avoided, as this too can accelerate the deterioration of any remaining renal function.

Prescription recommendations do not indicate whether manual PD (continuous ambulatory peritoneal dialysis, CAPD) or automated PD (APD) should be used, as this is a life style issue. Provided the recommendations on the lengths of the dwells are followed, all patients can choose either APD or CAPD based on their preference and life style. When negative ultra-filtration is suspected, as long as mechanical causes and lymphatic re-absorption have been excluded, the dwell time should be shortened rather than increase the glucose concentration of the dialysate. This will simultaneously result improve ultra-filtration and solute removal and avoid unnecessary exposure to glucose.