Peritoneal dialysis in patients with congestive heart failure

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Abstract

Background. Peritoneal dialysis (PD) may be a useful technique in the treatment of patients with congestive heart failure, both with and without primary end-stage renal disease (ESRD).

Methods. In the treatment of patients with ESRD and congestive heart failure (CHF), PD has theoretical advantages compared with haemodialysis (HD), such as the absence of an arteriovenous fistula and the more gradual fluid removal. In cohort studies, the incidence of heart failure was less as compared with HD, however, randomized studies on this aspect are lacking.

Results. As an acute rescue treatment of patients with treatment refractory heart failure, functional improvement has been observed with the use of PD. However, fluid removal is less predictable compared with continuous haemofiltration therapies.

Conclusions. As a long-term option for patients with treatment refractory CHF without ESRD, various case series showed improved functional performance and a reduction in hospitalization with the use of PD. However, also with the use of PD, median survival is still limited in these patients. Randomized studies are needed to establish the potential role of PD for this indication.

Introduction

Fluid state has to be regulated between narrow margins in patients with congestive heart failure (CHF). In patients with concomitant end-stage renal disease (ESRD), hypovolaemia may lead to hypotension that may exacerbate cardiac and cerebral ischaemia, whereas overhydration may lead to pulmonary oedema. In heart failure patients without ESRD, it may be very difficult and sometimes impossible to maintain the balance between pre-renal failure and clinical signs of fluid overload. Peritoneal dialysis (PD) provides the opportunity to remove excess fluid in a gradual manner. Whereas PD is a well-established technique in patients with ESRD and CHF, there is discussion about the relative advantages and disadvantages of PD for this patient category compared with haemodialysis (HD). For patients with CHF without ESRD, data are much scarcer, although case series showed promising results.

In this short review, the role of PD in the chronic treatment of patients with ESRD and CHF, its role as a rescue therapy in patients with CHF, and also in the long-term treatment of patients with CHF without ESRD will be discussed.

PD in patients with ESRD and CHF

The HEMO study found that the incidence of congestive heart failure in dialysis is >30% [1]. This is in line with USRDS data in incident patients [2]. In the HEMO study, symptoms of CHF improved in 16% of the patients after the start of dialysis, but also developed de novo during dialysis therapy in 17% of the patients. Patients with CHF and ESRD have a far worse prognosis than patients without heart failure. In a study by Parfrey and Foley [3], the 5-year survival of patients with systolic dysfunction of the heart was <10%. In a study, in incident patients by the same group, 5-year survival in patients with cardiac failure at the start of dialysis was virtually zero [4].

Data on the effect of PD in patients with CHF are scarce. Hebert et al. [5] followed 17 patients with a LVEF below 35%, of which 13 had clinical signs of CHF NYHA III or IV. Survival at 24 months was 64%. Ten of these patients had a second measurement of LVEF during the follow-up period, which increased from 23 ± 9 to 30 ± 8%.

There are no randomized studies that compared HD and PD in patients with CHF. Theoretical advantages of PD are the gradual fluid removal and
the absence of an arteriovenous access, which may, especially in case of a high flow fistula, exacerbate or cause signs of heart failure. Potential disadvantages of PD are the less predictable and, in case of peritoneal membrane failure, inadequate fluid removal [6].

In a large cohort study [7], hospitalization for heart failure was less in PD compared with HD. However, due to their uncontrolled nature, it is difficult to make solid conclusions from these observations.

Theoretically, the use of icodextrin would appear promising in patients with CHF due to its prolonged and gradual effect on peritoneal ultrafiltration [8,9]. However, icodextrin and standard glucose solutions have not been formally compared in PD patients with CHF.

To conclude, patients with CHF and ESRD have in general a limited life expectancy. Although, PD has theoretical advantages over HD in this patient population, the effect of both treatment modalities on outcome has not been compared in clinical studies. From a theoretical point of view, icodextrin appears promising, but has not yet been compared with standard glucose solutions in this patient population.

**PD as a rescue therapy in patients with CHF without ESRD**

A consequence of the reduction in renal perfusion due to forward failure in patients with heart failure is an increased activation of the renin–angiotensin and sympathetic nervous systems. This leads to renal vasoconstriction and increased proximal tubular sodium and water reabsorption. In turn, these phenomena cause a reduced distal sodium and water delivery, resistance to the effects of atrial natriuretic peptide and increased sensitivity of the distal nephron to the actions of aldosterone [10]. These mechanisms explain the occurrence of diuretic resistance. The concomitant fluid accumulation may lead to further reduction in cardiac output due to the Frank–Starling mechanism or a reduction in left ventricular inflow due to an increase in right ventricular diastolic volume [11].

Extracorporeal fluid removal may aid in the acute management of patients with severe congestive heart failure with insufficient response to diuretics. Theoretical advantages of these therapies are an improvement in cardiac output due to the Frank–Starling mechanism, an increased left ventricular diastolic inflow, and an improvement in lung compliance after removal of the excess fluid [11,12]. Moreover, a potential advantage above fluid removal by diuretics is the near-isotonic fluid removal with extracorporeal therapies compared with the hypotonic fluid removal with diuretics [13].

PD, isolated ultrafiltration or continuous haemofiltration have been used in the acute treatment of patients with congestive heart failure [13,14]. In various studies, the use of PD resulted in a reduction in plasma volume, improvement of hyponatraemia, an improvement in diuretic responsiveness and improvement in glomerular filtration [15,16]. Clinical improvement has also been obtained with the use of isolated ultrafiltration and continuous haemofiltration [13,17]. A theoretical advantage of PD above isolated ultrafiltration is the more gradual fluid removal, although this advantage also holds true for continuous filtration therapies. Moreover fluid removal is less predictable with PD compared with continuous haemofiltration. Yet, no controlled studies have compared the effectiveness of these different treatment modalities in the acute treatment of patients with acute cardiac failure.

A potential disadvantage of the use of PD in an acute situation is the occurrence of leaks. There are only few data on the occurrence of leaks after an acute start of PD, although early start of PD is usually considered a risk factor for pericatheter leaks [12]. In a study in 13 patients with congestive heart failure, in which PD was started immediately with low exchange volumes, no leaks occurred [19]. No further data with regard to the relation between pericatheter leaks and early start or filling volume are available in patients who used PD as an acute treatment modality for PD.

In the acute treatment prescription of patients with CHF, most often initial small volume (500–1000 ml) hypertonic glucose solutions with short dwell times (1–2 h), possibly through a cycler [14,15] are advocated, later on incrementally followed by larger exchange volumes (which will lead to more effective removal). With these treatment prescriptions, an hourly fluid removal of 67–568 ml/h was reportedly achieved [14,15]. Yet, data on the effect of PD as an acute treatment of cardiac failure on the long-term prognosis are very limited, which also holds true for other extracorporeal therapies. In 18 patients, unresponsive to diuretics and inotropic agents who were treated with isolated ultrafiltration, 78% showed an improvement in clinical status, but only 22% could be discharged from the hospital and 22% died after one session [17].

Summarizing, the use of extracorporeal treatment modalities, including PD, may result in clinical improvement in the acute treatment of patients with severe heart failure without ESRD, although its use so far is only supported by case series. However, the effect of extracorporeal treatment on the often dismal prognosis of these patients is not known and the experience still rather limited.

**Long-term management of patients with CHF without ESRD**

For the same reasons as previously mentioned, PD may also be useful in the chronic treatment of patients with CHF without ESRD. With more than 100 patients reported in the literature, the experience with PD as a chronic treatment for heart failure is larger compared with the acute situation [14,15,20–28]. Although, all the evidence available has to be derived from case series, the large majority of patients treated with PD and reported in the literature experienced
an improvement in functional status and in three of the four reports which addressed this parameter, also retrospectively a reduction in hospitalization was observed. Mean serum creatinine in these reports ranged from 1.7 to 4.4 mg/dl, although not in all reports, detailed data on renal function at baseline were provided [14,15]. Moreover, also data on the effect of PD on renal function are lacking.

Despite clinical improvement, the median survival of patients treated with PD in the reports available appears to be <1–2 years. Therefore, a definite beneficial effect of PD on outcome in these patients remains as yet to be shown. Moreover, despite the theoretical advantages above intermittent extracorporeal therapies, no comparative data are available. Comparable results, with an improvement in functional status and reduction in hospitalization compared with the previous period, were also reported with intermittent UF on an outpatient basis.

It is difficult to propose selection criteria for the initiation of PD in patients with treatment refractory CHF. Mousson et al. [20] were not able to define the criteria for the success or failure of PD as a chronic treatment in patients with CHF, although patients with CTR>70% or patients with prior need for ventilatory support fared worse.

PD in patients with CHF without ESRD is most commonly prescribed as an intermittent treatment with 1-3 exchanges/day, with glucose concentrations prescribed on an individual basis, although in most series hypertonic solutions were used [14,15,19,21]. No data on the use of icodextrin are yet available.

To summarize, positive experience with PD as a chronic treatment for patients with treatment refractory CHF is reported in the literature. However, all evidence has to be derived from case series. No comparative data of PD with other extracorporeal treatment modalities are available in these patients.

**Conclusion**

In patients with heart failure and ESRD, there is a wide experience with the use of PD, which has theoretical advantages compared with HD, although there are no comparative data on the effects of outcome and/or functional status between these two therapies. For the acute treatment of heart failure in patients without ESRD, experience with PD is limited, although in most series, functional improvement was shown. However, potential disadvantages of PD compared with continuous filtration therapies are the less predictable fluid removal and the possibility of early leaks.

As a long-term option in patients with CHF without ESRD, the use of PD reportedly resulted in an improvement in clinical symptomatology and a reduction in hospitalization. However, as yet, the only evidence has to be derived from case series and should be confirmed in randomized trials.

**Conflict of interest statement.** None declared.

**References**

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