Congestive heart failure (CHF), mainly because of ischemic heart disease, is becoming a common medical problem. As CHF worsens and reaches New York Heart Association (NYHA) class IV, many patients can become refractory to medical therapy, especially those who are elderly or who have pre-existing non uremic chronic renal failure. For such patients, quality of life, morbidity, and mortality are expected to be bad.

Our objective in the present study was to make a preliminary assessment of the usefulness of icodextrin administered in a single nocturnal peritoneal exchange to patients nonrespondent to the maximal conventional medical therapy. We studied two patients (aged 80 and 87 years), who were affected by severe dilatative cardiomyopathy and moderate-to-severe chronic renal failure.

After at least 12 months of treatment, we observed a significant improvement in quality of life and a reduction in morbidity and hospitalization in both patients. Both patients also significantly increased their creatinine clearance. One patient maintained ejection fraction stability (22%→27%); the other experienced an increase in ejection fraction to 50% from 25%.

These preliminary observations suggest that a single nocturnal exchange with icodextrin can be an effective treatment in patients affected by refractory CHF and moderate-to-severe chronic renal failure.

Key words
Congestive heart failure, icodextrin, ultrafiltration

Introduction
Congestive heart failure (CHF) affects nearly 5 million Americans and is the leading cause of hospitalization in adults older than 65 years (1,2). In Italy, as in the United States, the prevalence of CHF is about 1% in people aged between 50 and 59 years and about 10% in adults older than 80 years. These percentages will increase rapidly in the future, particularly because of the aging of the general population (3).

In many cases, CHF can worsen and become refractory. Patients who reach New York Heart Association (NYHA) class IV fail to respond to the maximal tolerable drug therapy (based on digitalis, diuretics, and vasodilators). Severe reduction of cardiac output leads to poor renal perfusion, reduced glomerular filtration rate, increased release of neurohumoral substances, and activation of reflex mechanisms that promote salt and water retention. Furthermore, diminished renal perfusion impairs the delivery of diuretics to their effector sites in the nephron, further contributing to salt and water retention. The increased extracellular fluid volume only serves to worsen the CHF and to reduce cardiac output. The progressive increase in diastolic volume—related both to the progressive salt and water retention and to a failing myocardium—brings a parallel increase in systolic intraventricular pressure. However, once diastolic volume reaches a critical high level, systolic intraventricular pressure actually starts to decrease, leading to CHF progression. This spiral results in a further decline in cardiac function, with accompanying refractory pulmonary edema, end-stage CHF, and death (4–6).

Ultrafiltration (UF) has a fundamental role in the treatment of refractory severe CHF (4). It can be used to temporarily improve cardiac output and to restore diuretic responsiveness; it can also be used to temporarily stabilize a patient for more definitive therapy such valve replacement or heart transplantation. Finally, in patients with severe CHF not amenable to
other therapies, chronic UF therapy is useful to keep the patient out of CHF (4–6).

Schneierson first reported the use of peritoneal dialysis (PD) in the management of refractory CHF in 1949 (7). Several investigators have studied the effect of PD on the hemodynamic parameters in the systemic and renal circulation. Fluid removal results in a reduction of plasma volume, an improvement in hyponatremia, and a reduction in pulmonary capillary wedge pressure. Better diuretic responsiveness has frequently been documented. The restoration of diuretic responsiveness is likely related to an improvement in renal hemodynamics: the use of PD results in an increase in the clearances of inulin and para-amino hippurate, and a reduction in filtration fraction (8–14).

Several studies have since reported the use of PD in the management of refractory severe CHF (15–27). At least 111 patients with CHF treated by long-term PD have been reported to date. In about half of those patients, PD was initiated solely for the management of CHF, because renal dysfunction was not sufficiently severe to start dialysis. Those studies demonstrated that, in such patients, 1–3 daily hypertonic exchanges with short dwell times maintain euvolemia.

Icodextrin-based PD solutions are now commonly available (28–34). Currently, only anecdotal reports are available on the use of icodextrin in individuals with refractory CHF (35–37). Here, we report our experience with two patients affected by severe dilatative cardiomyopathy and moderate-to-severe chronic renal insufficiency. These patients failed to respond to traditional medical therapies, and fatal outcomes were expected within months. They were favorably treated using a single nocturnal peritoneal exchange with icodextrin solution.

**Patients and methods**

Our prospective study enrolled two non uremic patients with severe refractory NYHA class III–IV CHF.

**Patient 1**

The first patient was an 80-year-old man affected by dilatative cardiomyopathy, severe mitral insufficiency, severe tricuspid insufficiency with moderate-to-severe pulmonary hypertension, and reduced ejection fraction (EF: 18% – 22%). He was classified as NYHA class IV. He also had an implanted bi-ventricular pacemaker. He suffered from moderate chronic renal failure (CRF), with a serum creatinine of 2.72 mg/dL and a creatinine clearance of 25 mL/min. Between May and December 2002, he had been admitted monthly for acute pulmonary edema and anasarca, and had been treated with intravenous diuretics. His chronic therapy included high-dose furosemide, angiotensin converting enzyme inhibitors (ACEIs), and digitalis. He followed dietary fluid (<750 mL/day) and salt restrictions. In January 2003, we started him on PD treatment with a single 2-L nocturnal exchange using icodextrin.

**Patient 2**

The second patient was an 87-year-old woman affected by post-ischemic dilatative cardiomyopathy, who in 1987 underwent a triple coronary artery bypass with aortic valve replacement. Her EF was 20%, and she was classified as NYHA class III. She had moderate CRF with a serum creatinine of 2.0 mg/dL and a creatinine clearance of 30 mL/min. In the preceding year, she had had several admissions for pulmonary edema and anasarca, at which time she was treated with intravenous diuretics. Her chronic therapy included high-dose furosemide, ACEIs, digitalis, and nitrates. In October 2002, we started her on PD treatment with a single 2-L nocturnal exchange using icodextrin.

**Icodextrin treatments**

For both patients, PD was started 2 weeks after implantation of a double-cuff Tenckhoff catheter. The icodextrin was instilled manually and dwelled intraperitoneally for 12 hours overnight. Patient 1 performed the procedure himself; patient 2 required the assistance of a family partner.

**Results**

Table I shows the main biochemical and clinical characteristics of the two patients.

**Patient 1**

At the time that the first patient started PD, his dry body weight was 63 kg and his 24-hour urine output was 2500 mL. After 12 months on PD, his dry body weight had increased by 4 kg due to gain of lean body mass. His creatinine clearance, calculated using the Cockcroft–Gault formula, had risen to 28 mL/min, and his 24-hour urine output had declined modestly (~700 mL). Daily UF was 1000 – 1500 mL. His EF
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Increased to 27% from 22%. During PD treatment, the patient was not hospitalized for cardiac or dialytic problems.

**Patient 2**

At the beginning of PD, the second patient’s dry body weight was 50 kg and her 24-hour urine output was 1500 mL. After 15 months on PD, her dry body weight had increased by 1 kg and her 24-hour urine output had also increased to 2000 – 2500 mL. Daily UF with icodextrin was 500 mL, and her creatinine clearance had increased to 35 mL/min from 30 mL/min. An echocardiographic study showed an increase in EF to 50% from 25%. Her NHYA classification improved from class III to class II. During PD treatment, this patient experienced no hospital admissions.

**Discussion**

Chronic peritoneal UF at home can be effective in the long-term management of severe CHF that has become refractory to conventional medical therapy. Daily UF improves volume control and lowers pulmonary capillary wedge pressure and right atrial pressure, reducing symptoms of congestion and improving functional class and morbidity. Furthermore, the treatment reduces the patient’s need for inotropes and may lower the risk of mortality from the well-known side effects of such medications.

In patients with severe refractory CHF, a single nocturnal peritoneal exchange with icodextrin is generally well tolerated, can be easily performed at home, and can reduce morbidity and hospitalization. It can therefore really improve quality of life, and thus is also cost-effective.

Compared with dextrose solutions, icodextrin offers certain advantages. It provides a more physiologic UF profile, because its action does not depend on its concentration gradient; the process of UF by colloid osmosis is slower and more progressive. Euvolemia is maintained without the need for additional exchanges with glucose-based solutions. The use of a single daily peritoneal exchange potentially reduces the risk of peritonitis from touch contamination and the possibility of complications related to PD per se. These aspects make icodextrin an attractive home PD option for treating refractory CHF.

Before starting home peritoneal UF, both of our patients needed to be hospitalized almost monthly. After 12 months of treatment, cardiac morbidity improved considerably, as demonstrated by the lack of admissions for cardiac or renal problems.

**Conclusions**

In our experience, home peritoneal UF can be proposed for patients with severe refractory CHF who have a high morbidity and require repeated admissions. The exact criteria for selecting patients who can benefit from home PD UF remain to be defined, and further studies are required to confirm the efficacy of the treatment.

**References**

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