



## EDITORIAL COMMENT

## Peritoneal dialysis in the time of coronavirus disease 2019

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### ABSTRACT

In the current setting of global containment, peritoneal dialysis (PD) and home haemodialysis are the best modalities of renal replacement therapy (RRT) to reduce the rate of transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection. Considering the shorter and easier training programme of PD compared to home haemodialysis, PD appears a practical solution for patients with end-stage renal disease to reduce the risk of hospital-acquired infection. PD offers the advantage of minimizing the risk of viral transmission through interpersonal contact that commonly occurs during the haemodialysis session and while travelling from home to the haemodialysis facility using public transport services. To overcome barriers to health care access due to the containment measures for this emerging disease, telemedicine is a useful and reliable tool for delivering health care without exposing patients to the risk of contact. However, novel issues including handling of potentially infected dialysate, caregivers' infectious risk and adequacy of PD in critically ill patients with acute respiratory distress syndrome remain to be clarified. In conclusion, PD should be preferred to the other modalities of RRT during the coronavirus disease 2019 (COVID-19) outbreak because it can be a solution to cope with the increased number of infected patients worldwide.

**Keywords:** coronavirus, COVID, dialysis, peritoneal dialysis, SARS-CoV-2, telemedicine

Coronavirus disease 2019 (COVID-19) is an emerging and concerning infection, spreading globally from December 2019. The disease is prevalently asymptomatic or paucisymptomatic, but carries a ~10–30% of mortality among hospitalized patients [1–3]. The population with a worse outcome includes elderly subjects affected by diabetes and hypertension [1, 2]. There is no doubt that many patients on renal replacement therapy (RRT), including those on peritoneal dialysis (PD), are at high risk for

severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection. This vulnerable subset of the population, aged >60 years, has a high amount of comorbidities including metabolic and cardiovascular diseases [4].

In these circumstances, the main advantage of patients being on PD is that they can carry out the dialysis treatment in their own homes. Performing home dialysis treatment, a PD patient can minimize interpersonal contact by avoiding the need

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to reach the haemodialysis facility three times a week. In addition, the patient nullifies exposure to the virus while travelling from home to the centre on public transport services and waiting for the start of the dialysis treatment. In addition, PD patients have the advantage of reducing close contact with health-care workers, who can be potentially affected by SARS-CoV-2 infection [5]. PD appears, therefore, as the best RRT for patients with end-stage kidney disease during the COVID-19 outbreak, as contact plays a crucial role in the spread of this infectious disease.

With the rapid spread of the virus in Northern Italy, we have faced a new condition never experienced before. The increase in the number of notified cases of COVID-19 has been rapid, with very little time to manage this evolving situation. The national public health response has been focused on the treatment of severely ill SARS-CoV-2-infected patients, with a redistribution of the medical services according to a priority setting of health interventions. As a result, radical changes have been made to the care of PD patients as a consequence of new and emerging COVID-19-related issues (Table 1).

According to the recommendation of the World Health Organization [6] and International Society for Peritoneal Dialysis [7], delivery of health care services for PD patients has undergone profound changes in response to the COVID-19 outbreak. Telemedicine has been implemented first in clinical practice. This umbrella term encompasses all health-care services delivery at a distance using electronic means including phone, webcam or other electronic devices. Knowing the patient's health conditions, despite this emerging situation, is fundamental to maintain a high standard of care and a stable patient-clinician relationship. Data about body weight, diuresis, peritoneal ultrafiltration, arterial blood pressure and heart rate are indispensable to recognize variation from the baseline. In

absence of signs or symptoms of inadequate deuration, periodic PD clinic visits, normally scheduled every 4 weeks, can be lengthened to 8–10 weeks, according to the clinical characteristics of the patients. Furthermore, we have noted that maintaining a regular relationship with the patient can help to relieve anxiety and vulnerability caused by this stressful situation.

A preventive telephonic triage is required to screen patients and caregivers for symptoms of acute respiratory illness (e.g. fever, cough, shortness of breath) before coming to our facility. Health-care providers should maintain a high index of suspicion for all patients, and a triage system must be set up to intercept suspected cases. Symptomatic patients are addressed, according to the local policy, to facilities or a specialized team able to screen for SARS-CoV-2 infection. An alternative strategy is to direct the patient, wearing a surgical mask, into a separate area (an isolation room if available). At least 1 m distance must be kept from other patients [6]. According to our local policy, a febrile patient, even if there is suspicion for bacterial peritonitis, is treated as a suspected case and invited to present to the emergency room, where lab examinations, chest X-ray and swab for SARS-CoV-2 are rapidly performed.

Based on our limited experience (two confirmed cases), a high-level alert is required to ensure early diagnosis and appropriate management of COVID-19. Briefly, the first patient (72 years) with a medical history of ischaemic heart disease reported dyspnoea and fever at the time of admission. The radiologic signs of acute pulmonary oedema were misleading and led towards a primary diagnosis of heart failure due to fluid overload. Atypical pneumonia was mild and the subject had a good prognosis. The second patient (64 years), who had been self-isolated at home for SARS-CoV-2 infection, was admitted for hypoxaemia due to a rapid worsening of pulmonary function. Severe lung involvement and multiple comorbidities led to

**Table 1.** Emerging COVID-19-related issues in PD

COVID-related issue	Strategy
Restricted access to PD facility	Routine use of telemedicine Replace in-centre visit with on-demand or scheduled appointment
PD urgency	Telephone triage to screening for COVID-19-related symptoms Pre-facility triage Do not exclude COVID-19, consider nasopharyngeal swab in patients with suspicious SARS-CoV-2 infection
PD patient with COVID-19 at home	Close monitoring of vital signs (breathing rate, oxygen saturation, fever, dyspnoea) Low threshold for hospital admission
PD patient with COVID-19 in hospital or health care facility	Consider low-volume APD for mild ARDS (maintain a low IAP with small fill volume) Consider a switch to extracorporeal dialysis for moderate to severe ARDS or worsening of oxygenation and/or mechanical ventilator parameters following instillation of peritoneal dialysate PD patient in prone positioning requires abdomen suspension to allow dialysis exchanges and peritoneal UF
Peritoneal dialysate effluent and disposable material	Consider peritoneal fluid and disposable material potentially infectious (see local regulation for safe disposal)
Supply of PD material	Some companies can limit the delivery of PD supplies at one delivery location to once in every 30 days
People in close contact with COVID-19 patient (e.g. caregiver, delivery driver of PD companies)	According to local privacy regulations, alert caregiver or others of the high transmissibility of the infection Use of PPE
SARS-CoV-2 re-infection	Monitor nasopharyngeal swabs and serologic tests

ARDS, acute respiratory distress syndrome; IAP, intra-abdominal pressure; PD peritoneal dialysis; PPE, personal protective equipment; UF, ultrafiltration.

an unfavourable clinical course; he died of sepsis 7 days after admission.

The latter case underlines that frail patients, even with mild symptoms, need close monitoring of their respiratory function to prevent the risk of a severe tardive presentation. Patients in self-isolation at home must regularly check body temperature and oxygen saturation by pulse oximetry. To better evaluate the pulmonary function, oxygen saturation should be measured also after a moderate effort such as a 6-min self-paced walking. Decrease of oxygen saturation under the cut-off of 93% in patients not affected by lung disease needs specialist evaluation and chest X-ray. Another parameter that is particularly useful is the measurement of the breathing rate [8]; a value >25 breaths per minute is used in clinical practice as a sign of respiratory distress.

Admitted PD patients waiting for an oropharyngeal swab test result or having a documented infection should be treated with all precautions, which range from a negative pressure room to personal protective equipment (PPE). A minimum number of health-care workers and medical devices should be exposed to the case, and contact should be limited in duration to reduce virus transmission. These precautions are also valid for patients necessitating a caregiver at home.

The main issue that has been raised during the COVID-19 outbreak is the risk of contamination with the handling of dialysate. SARS-CoV-2 has been recently identified in PD effluent, but it is unclear if the virus has the potential to replicate [9]. Viral RNA was also documented in peritoneal fluid during SARS outbreak in 2003 [10]. These findings show that dialysate is a potential source of the most severe strains of coronavirus and therefore, should be managed very cautiously. Safe disposal of PD effluent is subject to local regulation. For PD patients on automated peritoneal dialysis (APD), the discharge dialysate should be drained, through an extension line, below the surface of the water of the toilet bowl or tank to avoid the spread of aerosols generated from the contaminated fluid. Self-sufficient patients on continuous ambulatory peritoneal dialysis should pour the discharge dialysate into the toilet bowl. Health-care workers or caregivers should decontaminate the bag with sodium hypochlorite and throw the intact bag out in unsorted garbage; otherwise, the drain bag should be poured into the toilet bowl. PPE is necessary to prevent infection from aerosol droplets.

Another issue of great interest is the impact of PD on pulmonary function. Given that COVID-19 manifests with respiratory symptoms and hypoxia, the choice to continue PD in patients with respiratory distress should be considered very carefully. PD has the potential to compromise respiratory function. Early studies in PD patients demonstrated that 2L of dialysis fluid in the abdomen resulted in a reduction of most lung volumes, impairing blood oxygenation due to ventilation-perfusion mismatch [11]. It was established that PD treatment was associated with a decrease of 8 mmHg of arterial PO<sub>2</sub> in the supine position. A long-term adjustment including the re-distribution of blood away from the scarcely ventilated segments of the lungs seem to nullify the decrement of O<sub>2</sub> [12], albeit the reduction of the functional residual capacity can persist. Prone ventilation is a useful strategy utilized to ameliorate oxygenation and lung mechanics in patients with severely hypoxaemic acute respiratory distress syndrome (ARDS) [13]. The survival benefit of prone positioning [14] appears to depend on the recruitment of dorsal lung units, improvement of ventilation/perfusion matching and prevention of ventilator-induced lung injury [15, 16]. A single case documents the successful use of prone ventilation in a

hypoxaemic PD patient with neurogenic pulmonary oedema. The risk of intra-abdominal hypertension due to the installation of peritoneal dialysate was counteracted with the prescription of an APD programme of 40 L for >24 h and the maintenance of the intra-abdominal pressure <18 mmHg [17].

In light of this evidence, the prescription of a low-volume APD programme can be a solution in patients with mild ARDS (200 < PaO<sub>2</sub>/FiO<sub>2</sub> ≤ 300 mmHg) [18]. In intubated patients, PD should be performed in prone position along with the suspension of the abdominal cavity. This strategy allows unloading the abdomen to avoid an undesirable rise of intra-abdominal pressure, especially in patients with a large abdomen that protrudes beyond the ribcage [19]. Maintaining low intra-abdominal pressure is mandatory to achieve desirable ultrafiltration and favour lung mechanics.

A temporary switch to haemodialysis or continuous RRT is advocated in severely ill PD patients with severely compromised lung function and patients with a worsening of ventilator parameters following the instillation of peritoneal dialysate (i.e. tidal volume, FiO<sub>2</sub>, positive end expiratory pressure, etc.).

According to the current global containment strategies, PD is the best dialysis modality to prevent cross-infection in dialysis patients and diffusion of the virus in health-care facilities. The principal limiting factor that counterbalances the benefit of home dialysis is the currently limited assistance that can derive from the reduction of essential health services during COVID-19 outbreak. For this reason, additional efforts, such as the implementation of telemedicine services, should be made to maintain a high standard of care and to endorse the high benefit of home dialysis over in-centre haemodialysis.

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### CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest. This article does not contain any studies or data on human participants or animals performed by any of the authors. Informed consent is not applicable because this study is a review. The authors declare that this manuscript has not been submitted to other journals.

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