



## LETTER TO THE EDITOR

## Home dialysis machine use for emergency dialysis during the COVID-19 pandemic

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The coronavirus disease 2019 (COVID-19) pandemic resulted in a reduced number of beds available for patients with other pathologies, such as acute kidney injury (AKI) [1]. We describe the adaptation of our renal intensive care unit (RICU) during the pandemic and novel use of home dialysis machines to provide emergency dialysis.

In late March 2020, in order to increase the critical care capacity of our hospital for COVID-19 patients, we converted our 15-bed RICU in Tenon Hospital (Paris, France) to intensive care beds, transferring the unit to another hospital (Pitié-Salpêtrière, Paris, France) with capacity for 6 monitored beds. The nursing staff within this new RICU was neither dialysis-trained nor was there an ultrapure water supply to provide haemodialysis. Although haemodialysis was feasible during the day in the hospital dialysis unit, emergency dialysis could only be provided at night in the intensive care department, which was already overburdened with COVID-19 patients. As a solution, we acquired a home dialysis machine (Physidia S3, Physidia, Saint-Barthélémy d'Anjou, France) on which the medical staff were trained by the manufacturer in a half-day course. This machine allows 2–3 h of dialysis via a central venous catheter or arteriovenous fistula. Instead of the use of a reverse osmosis water circuit, pre-prepared bagged sterile fluid is used. The dialysis

potassium concentration is fixed at 1 mmol/L. The maximum hourly ultrafiltration is 1 L and no anticoagulation is needed. Within 2 days, four residents and three nephrologists could set up the machine.

From 30 March to 5 May, 34 patients were admitted in the relocated RICU. The reasons for hospitalization were AKI ( $n=24$ ), end-stage renal disease (ESRD;  $n=6$ ) and electrolyte disorders ( $n=4$ ). Causes of AKI were acute tubular necrosis ( $n=7$ ), cardiorenal syndrome ( $n=5$ ), anti-neutrophil cytoplasmic antibody (ANCA) vasculitis ( $n=3$ ), anti-glomerular basement membrane (GBM) disease ( $n=1$ ), malignant hypertension with thrombotic microangiopathy ( $n=2$ ), scleroderma renal crisis ( $n=1$ ), hemolysis elevated liver enzymes, low platelets syndrome ( $n=1$ ), graft rejection ( $n=1$ ) and post-renal ( $n=2$ ) and myeloma cast nephropathy ( $n=1$ ). For eight patients, at least one emergency haemodialysis session with the home dialysis machine was performed. There were 21 dialysis sessions in total during this period using the new device. The patients' characteristics are shown in Table 1. The most common first emergency dialysis indication was fluid overload ( $n=6$ ), followed by hyperkalaemia ( $n=1$ ) and ESRD with uraemic symptoms ( $n=1$ ). Blood flow and dialysate rates were low (150–220 mL/min and 150–200 mL/min, respectively).

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Table 1. Characteristics of patients requiring emergency dialysis with home dialysis machine

Patient	Age (years)	Gender	Other pathologies	Cause of kidney failure	Session indication	Vascular access	Session length (hours)	Blood flow rate (mL/min)	Dialysate rate (mL/min)	Ultrafiltration (L)	Number of sessions	Complications	URR (%)	K <sup>+</sup> before	K <sup>+</sup> after
1	55	M	HIV	ATN	Fluid overload	Catheter	2	220	150	1.8	1	None	31	3.9	3.0
2	59	M	Diabetes mellitus, hypertension	Nephroangiosclerosis and diabetic nephropathy	Fluid overload	Catheter	2	220	150	1.8	1	None	25	5.1	3.4
3	74	M	HIV, hypertension	Unknown	HyperK	Fistula	2	220	200	1.5	1	High venous pressure	32	6.1	5.2
4	74	M	Diabetes mellitus, hypertension	Cardiorenal syndrome	Fluid overload	Catheter	2	220	150	1.8	1	None	17.8	4.5	3.7
5	68	F	Obesity	Goodpasture disease	Fluid overload	Catheter	2	220	150	1.7	10	None	37.3	4	3.5
6	35	M	Hypertension	ANCA vasculitis	Fluid overload	Catheter	2	220	150	1.7	2	High venous pressure	15.7	4.9	4.1
7	57	F	None	ANCA vasculitis	Fluid overload	Catheter	2	220	150	1.9	3	Low arterial pressure	37.7	3.7	2.9
8	74	M	Cardiac	transplantation, diabetes mellitus	CNI/ cardio renal syndrome	Fluid overload	Catheter	2	150	150	150	1	2	None	26.1
4-9	3.7														

Kalaemia (K<sup>+</sup>) values and URR were calculated on the first session. ATN: acute tubular necrosis; CNI: calcineurin inhibitor; HyperK: hyperkalaemia; URR: urea reduction ratio.

Only one patient was dialysed using an arteriovenous fistula and the remainder required emergency central venous catheterization. Small molecule clearance was estimated using the urea reduction ratio: the median rate was 26% (interquartile range 25–75:23–31). Patient 5 had 10 sessions of combined haemodialysis and plasma exchange (PEX) for anti-GBM (anti-glomerular basement membrane) disease, as we were able to connect both the haemodialysis and the PEX machines in parallel on her catheter. Haemodynamic tolerance was optimal for all the patients and we noted no catheter-associated infection or symptomatic hypokalaemia.

In order to ensure continuity of nephrology critical care (for non-COVID-19 patients) and reduce pressure on other emergency departments, our renal RICU was maintained but relocated during the pandemic. To our knowledge, this technique has never been used in a critical care context. The use of home dialysis machines has been associated with increased survival [2] and quality of life [3] in ESRD patients. We demonstrated that the technique can be useful for AKI treatment in a time of crisis, with a short training period for medical staff with good results. Our experience shows that it is easy to handle and safe.

In conclusion, we describe the use of a home dialysis machine for emergency dialysis with good results and tolerance during the COVID-19 pandemic. We believe this innovative technique could be of interest in other contexts, such as emergency dialysis in low-income countries or disaster sites with no facilities for water treatment.

### AUTHORS' CONTRIBUTIONS

The research idea and study design were carried out by Y.L., L.M. and E.R. Data acquisition was performed by C.M., V.M., A.P., C.S. and H.G. Data analysis/interpretation was performed by C.M. and Y.L. Supervision or mentorship was provided by L.M. and E.R. J.T., I.M., P.G., S.S., M.C. and N.A. provided critical feedback and helped shape the research, analysis and manuscript.

Each author contributed important intellectual content during manuscript drafting or revision, accepts personal accountability for the author's own contributions and agrees to ensure that questions pertaining to the accuracy or integrity of any portion of the work are appropriately investigated and resolved.

### CONFLICT OF INTEREST STATEMENT

The authors report that they have no relevant financial interests. The results presented in this article have not been published previously in whole or part.

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### DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author, YL, upon reasonable request.

### REFERENCES

1. Verelst F, Kuylen E, Beutels P. Indications for healthcare surge capacity in European countries facing an exponential increase in coronavirus disease (COVID-19) cases, March 2020. *Eurosurveillance* 2020; 25: 2020323
2. Kjellstrand CM, Buoncristiani U, Ting G et al. Short daily haemodialysis: survival in 415 patients treated for 1006 patient-years. *Nephrol Dial Transplant* 2008; 23: 3283–3289
3. Wyld M, Morton RL, Hayen A et al. A systematic review and meta-analysis of utility-based quality of life in chronic kidney disease treatments. *PLoS Med* 2012; 9: e1001307