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Case report/narrative review

Peritoneal Dialysis in adult Intensive Care Unit: Case report and literature review

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ABSTRACT

Peritoneal Dialysis in adult Intensive Care Unit: Case report and literature review.

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Choice of peritoneal dialysis over other renal replacement therapy modalities for adult critically ill patients is still limited; despite the data against it. The present article presents a case of peritoneal dialysis in a patient with intracerebral hemmorhage and reviews the relevant literature.

Keywords: Peritoneal dialysis, intensive care, acute renal failure

INTRODUCTION

Though peritoneal dialysis (PD) is one of the first described renal replacement therapy option (RRT) and its advantages over haemodialysis (HD), its availability worldwide varies between 76-81%[1-2] (Table 1).

Moreover, large inter- and intraregional disparities exist in PD availability, accessibility, affordability, delivery, and reporting of quality outcome measures around the world, with the greatest gaps observed in Africa and South Asia[2-3]. When it comes to usage of PD in critical care setting, data get even more limited; since the vast majority of Intensive Care Units' (ICU) patients receive either continuous or prolonged intermittent haemodialysis therapies (Table 2).

The International Society of Peritoneal Dialysis (ISPD) recommends that PD be considered a suitable modality for treatment of AKI in all settings (1B)[4]. This applies to continuing PD in

patients with established kidney failure who have already been on maintenance PD.

Table 1. Advantages of PD over HD

- Lower requirement for highly trained personnel
- Lower requirement major infrastructure
- Lower risk of bacteremia.
- Avoid vascular access
- Gradual solute removal
- Lower cost
- More patients managed per nephrologist

Table 2. Modes of renal replacement therapies

IHD: intermittent hemodialysis IUF: intermittent ultrafiltration
C(A/V)VVH: continuous (arterial or veno) venous hemodialysis C(A/V)VHD: continuous (arterial or veno) venous hemodialysis C(A/V) VHDF: continuous (arterial or veno) venous hemodiafiltration HVHF: high volume hemofiltration SCUF: slow continuous ultrafiltration
SLEDD: sustained low efficiency daily dialysis SLEDD-F: sustained low efficiency daily dialysis, with filtration
RAD: renal tubule assist device CPFA: coupled plasma filtration adsorption
PD: peritoneal dialysis CAPD: continuous ambulatory PD CMPD: continouous mobile PD HVPD: hig volume PD APD: automated PD CCPD: continuous cycling PD NIPD: nocturnal intermittent PD TPD: tidal PD

In the present article we present a case report as a starting point for a narrative literature review about the use of PD in ICUs, and we examine the validity of some concerns regarding the ap-

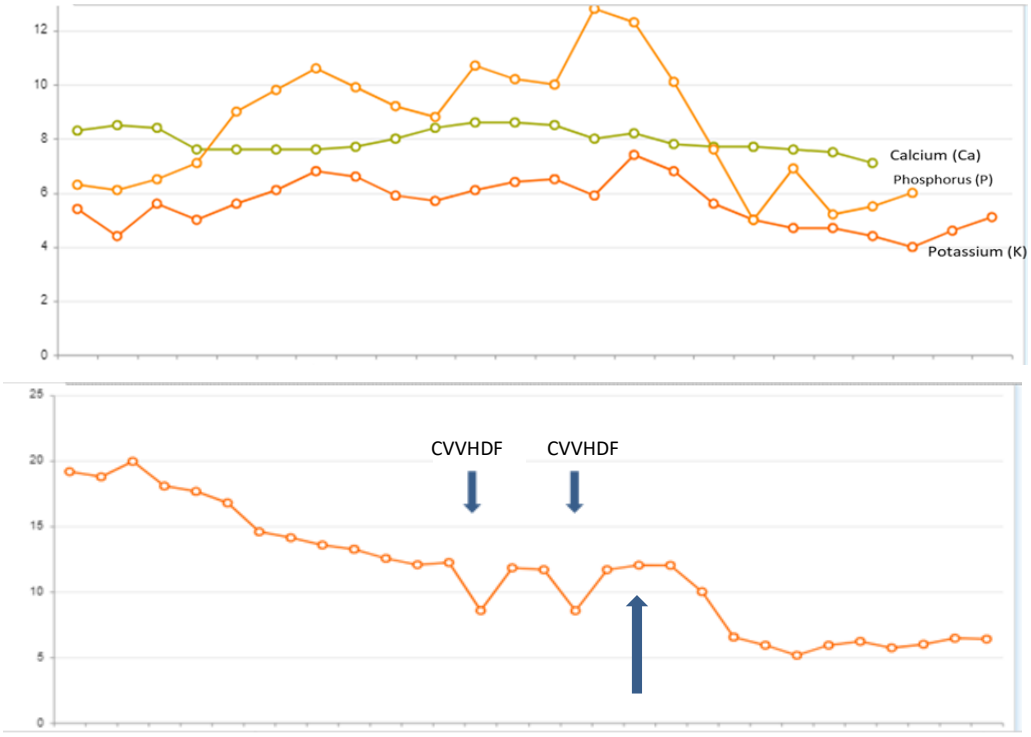
plication of that therapeutic option in critically ill patients.

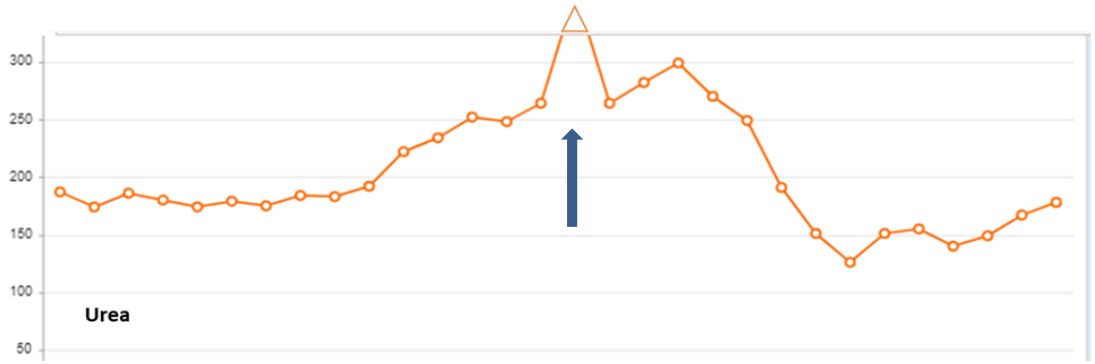
CASE REPORT

A 53-year-old man was admitted to our ICU with a diagnosis of intracerebral hemorrhage (ICH). The patient was transferred to Emergency Department (ED) of another hospital due to "acute comatose state". Medical history included refractory hypertension related end-stage renal disease (ESRD) on PD for the last 5 years, and sleep apnea. ED clinical examination revealed: Glasgow coma scale (GCS): E3/V1/M2-3, mydriasis (4mm/3mm), irregular breathing pattern, heart rate (HR) of 75 bpm and arterial blood pressure (BP) 300/160 mmHg. The patient was intubated, an emergency CT (computed tomography) - revealing a large intracerebral hemorrhage- was conducted, while an intense attempt to control BP was made. After insertion of an external ventricular drain (EVD) for the ICH and an emergency HD session due to increased serum creatinine and urea (20.01 and 292 respectively), the patient was admitted to our hospital.

The patient remained 28 days in our ICU, before transferred to another hospital due to gastric hemorrhage, during which RRT was mainly achieved via PD and two sessions of CVVHDF. The main determinants for the choice of PD were i) reason of admission, ii) coagulation disturbances and iii) difficulty in vascular access (stenosis of left femoral vein). Calculated weekly Kt/V* achieved was 1.98 and the course of serum creatinine, urea, potassium, calcium and phosphorus are displayed in the following graphs (Graph 1).

Graph 1. Time course of different laboratory parameters.





**K: dialyzer clearance of urea, t: dialysis time, V: volume distribution of urea. Blue arrows: CVVHDF, 2 sessions only.*

PD AND OUTCOMES

Though earlier studies on PD in critically ill have been terminated due to high mortality[5], subsequent reports showed more promising outcomes[6]. There are even emerging studies examining the use of PD in patients with Acute kidney injury (AKI) and specifically in those with critical illness, that report better results- in term of survival, ICU length of stay, infections' complications, and recovery of kidney function- in comparison with CRRT[7].Moreover, the rate of ICU admission among patients on PD is low at 13.3 admissions per 100 patient–years compared to rates of ICU admission in the overall ESKD cohort was greater at 19.5 per 100 patient–years[8-9].

With COVID-19 pandemic, many ICUs were forced to implement PD programs since other RRT capacities were overwhelmed[10-14]. There are even reports from PD application in prone position, with an improvement in post-prone PaO_2/FiO_2 ratio recorded in almost all patients[11]. The overall results (survival, complications) and the PD mode used, vary from centre to centre, depending on the staffing, organisation, previous experience. Moreover, in several cases a combination of PD - HD modes were used (e.g., APD-CVVHDF, or PD-IHD)[10]. Surgical protocols for bedside PD catheter placement in critically ill were also applied[12].

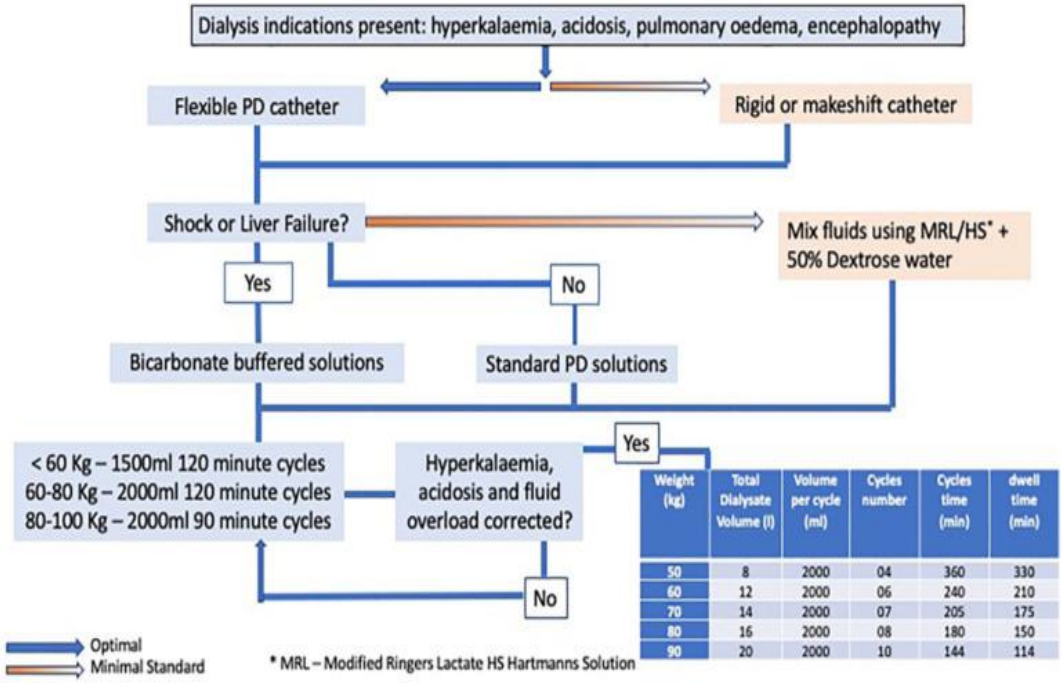
Prescribing dose

The current ISPD guidelines recommended a weekly target Kt/V of 2.2. The prescription is recommended to be of 2 L dwell volume and 2 h dwell time, resulting in approximately 24 L of dialysis per day. The dwell cycles can be increased to 4–6 h following appropriate metabolic control[4] (Figure 1). However, there are studies that report similar results to HD with a weekly target Kt/V up to 3.6[15]. In any case, appropriate dose for acute PD is still to be defined. We usually think PD in weekly Kt/V, but in the dynamic ICU setting daily Kt/V is more useful. We can make this information useful in guiding drug prescription and comparing clearances of PD and CRRT (when a transition is needed). The weekly Kt/V can be used for calculation of clearance of urea K in ml/min. For

example, in our patient (BW=75 kg): $V=V_{total\ body\ water}$~0.6 x 75 (BW) =45 lt, Kt/V=1.98⇒K= (1.98 x V)/time⇒ K= 89.1/week=12.73 l/d~8.85 ml/min.

The ISPD guidelines suggest that that a daily Kt/V 0.5 in critically ill patients with AKI provide a comparable to HD outcome[4].

Figure 1. ISPD guide for acute peritoneal dialysis prescription[4].



Weight (kg)	Total Dialysate Volume (l)	Volume per cycle (ml)	Cycles number	Cycles time (min)	dwell time (min)
50	8	2000	04	360	330
60	12	2000	06	240	210
70	14	2000	07	205	175
80	16	2000	08	180	150
90	20	2000	10	144	114

Effects on intraabdominal pressure and mechanical ventilation.

Normal IAP of an empty abdomen is low at 0.5 to 2 cm H_2O, but in the setting of critical illness IAPs of 6 to 9 cm H_2O is usual and can be considered normal. In PD the increase in IAP is proportional to dialysate fluid. In a recent study, theIAP measure pre- and post-PD showed only a temporary increase (maximum was 10.2 ± 5.9 mm Hg) and returned to values very close to basal levels (8 to 9 mm Hg) by the third day[16]. In more complex cases, intermittent monitoring of IAP (for maintaining IAP<13 mmHg), can also be used to modify dialysate fluid[16]. In the same study, improved respiratory parameters were also recorded: progressive increase in pulmonary compliance, and a significant increase in PaO_2/FiO_2 and FiO_2; a fact that had been long known for paediatric population[17].

Complications and contraindications; care of the PD catheter

Compared to CRRT therapies, mechanical complications and infections are lower with PD[7]. Cost and equipment are lower than CRRT therapies[7,18]. PD is contraindicated in large mesenteric resections, cutaneous feeding tube *in situ* (gastrostomy), known peritoneal defects or pleural communications (pleuroperitoneal shunt), severe active psychosis, severe physical deformities, large abdominal hernias and other

conditions that should be assessed at the bedside (obesity, multiple adhesions, documented type II ultrafiltration failure, active bowel ischemia, abdominal abscess, or in woman din the third semester of pregnancy)[17].

In any case, when we need transition to temporary haemodialysis and the PD catheter is to remain in place, proper care should be taken.

The latter include timely exit site care and intermittent small volume flush to maintain catheter patency (usually every 2-4 weeks) and strategize to preserve any residual renal function (if present) when on HD.

CONCLUSIONS

Large, randomised control trials (RCTs) that compare PD to other RRT are limited; thus, future studies may need to change the status of PD in ICU. However, current data- and ISPD guidelines- suggest that PD is a feasible staff-, time- and cost-sparing alternative to other HD modalities for ICU.

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The authors declare that they have no competing interests.

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