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Advances in Peritoneal Dialysis in Acute Kidney Injury

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ABSTRACT

In the 1970s, acute peritoneal dialysis (PD) was widely accepted for the treatment of acute kidney injury (AKI), but this practice has declined in favor of extracorporeal therapies, mainly in developed world. The lack of familiarity with the use of PD in critically ill patients has also led to a lack of use even among those receiving maintenance PD. Renewed interest in the use of PD for AKI therapy has emerged due to its increasing use in low- and middle-income countries due to its lower cost and minimal infrastructural requirements. In high-income countries, the coronavirus disease 2019 pandemic saw PD for AKI used early on, where many critical care units were in crisis and relied on PD use when resources for other AKI therapy modalities were limited. In this review, we highlight the advantages and disadvantages of PD in AKI patients and indications and contraindications for its use. We also provide an overview of advances to support PD treatment during AKI, discussing PD access, PD prescription, complications related to PD, and its use in particular clinical conditions. (REV INVEST CLIN. 2023;75(6):327-36)

Keywords: Peritoneal dialysis. Acute kidney injury. Critically ill patients. Dialysis.

INTRODUCTION

Acute kidney injury (AKI) is associated with high mortality among patients admitted to intensive care units (ICU)[1-3]. Peritoneal dialysis (PD) was historically the initial acute kidney replacement therapy (AKRT) modality successfully used in patients with AKI and widely utilized well into the 1980s[4-6]. Although it is the most common AKRT method used for pediatric AKI patients, and a commonly used AKI treatment modality in adults in many middle- and low-income countries, the use of PD in AKI in critically ill patients has declined across high-income countries. This is attributable to the introduction of and advances in extracorporeal continuous AKRT[7,8].

A recent resurgence of interest in the use of PD for AKI treatment in high-income countries was largely related to the coronavirus disease 2019 pandemic. The pandemic saw critical shortages of resources and staff needed to provide hemodialysis (HD) and continuous AKRT and many centers relied on PD for AKI treatment[9,10].

The International Society for Peritoneal Dialysis (ISPD) has published updated guidelines for PD treatment for AKI indicating PD as an acceptable form of AKRT in all settings[6] and two meta-analyses showed that PD is non-inferior to extracorporeal therapies in the treatment of AKI patients AKI[11,12].

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TECHNICAL ASPECTS AND CONTROVERSIES

The use of PD in AKI is enhanced by the placement of a Tenckhoff catheter by a nephrologist, which can be safely accomplished at the bedside. PD offers several advantages over HD, such as technical simplicity and a lower risk of bleeding (Table 1). The gradual and continuous nature of PD ensures that disequilibrium syndrome is prevented and that cardiovascular stress is minimal, which reduces the risk of renal ischemia and fluid-electrolyte imbalance[13-19]. This may explain why previous studies have shown higher rates of kidney recovery with PD compared to intermittent HD (iHD) or CKRT[20,21].

Besides the classical indications (volume overload, electrolyte disorders, uremic symptoms, or acid-base disturbances), PD can also be used to maintain volemic control in patients with congestive heart failure (functional Class IV) and control hyper and hypothermia. In the setting of natural disasters, when several victims develop AKI and damage to infrastructure makes access to power, clean water, and facilities for water treatment unavailable, PD is an important and life-saving renal replacement therapy (RRT) modality[13-20].

It is also true that PD is not the most efficient therapy: clearance per exchange can decrease if a shorter dwell time is applied, a lower efficiency can be observed in large-sized and severely hypercatabolic patients, fluid removal can be unpredictable, there is a risk of infection, and there are possible issues with mechanical ventilation[21-25]. PD is relatively contraindicated in patients with recent abdominal surgery, abdominal hernia, adynamic ileum, intra-abdominal adhesions, peritoneal fibrosis, or peritonitis. Table 2 shows the contraindications of PD.

Since volume and solute removal are slow and unpredictable, PD is not as efficient as extracorporeal blood purification techniques for the treatment of emergencies such as acute pulmonary edema or life-threatening hyperkalemia[18,19,25-27]. Another possible limitation of PD in AKI is that associated protein losses may aggravate malnutrition. Protein losses as high as 48 g/day have been reported, but some reports document maintenance of serum albumin levels[27]. Protein supplementation, either enteral or parenteral (1.5 g/kg/day) is recommended for AKI patients on PD[28-31].

Table 1. Advantages and disadvantages of PD in AKI

Advantages	Disadvantages
Technically simple	It requires intact peritoneal cavity with adequate membrane function
No need for expensive equipment	It may not be adequate for severe acute pulmonary edema or life-threatening hyperkalemia
It avoids vascular access	Infection (peritonitis) can occur
It ensures minimum blood loss exactly predicted	Ultrafiltration and clearance cannot be
Biocompatible	It can cause protein losses
Useful in all types of AKI	It can cause hyperglycaemia and Hypernatraemia
More rapid renal recovery	It may impair respiratory mechanics
It provides continuous RRT and cardiovascular stability	Lactate buffer
Beneficial in select patients population (children, heart failure, cirrhosis, bleeding diathesis)	

Table 2. Relative contraindications of PD in AKI

Recent abdominal and/or cardiothoracic surgery (< 30 days)
Diaphragmatic peritoneal-pleural connections
Severe respiratory failure (FiO2 > 70%)
Life-threatening hyperkalemia (characteristics change sin EKG)
Extremely high catabolism (NB > - 10 g/day)
Severe volume overload in a patient not on a ventilator
Severe gastroesophageal reflux disease
Low peritoneal clearances
Fecal or fungal peritonitis
Abdominal wall cellulitis
AKI in pregnancy (catheterimplantation after 12 weeks)
Malnutrition where further protein losses are unacceptable

The high glucose concentrations in peritoneal dialysate may cause hyperglycemia, even in non-diabetic patients. This is easily correctable through intravenous or intraperitoneal administration of insulin. Previous

studies have reported that PD can increase intra-abdominal pressure (IAP), which leads to impaired diaphragm mobilization, and decreased pulmonary compliance and ventilation, which may cause or worsen respiratory failure[33,34]. However, PD is seldom the cause of ventilation impairment in patients without pulmonary disease.[24] Results from our group suggest increases in the pulmonary compliance without changes in IAP in AKI patients treated with PD[35].

EVIDENCES AND GUIDELINES

Recently, interest in using PD to manage patients with AKI has been increasing. The first question that must be asked is whether PD can provide adequate clearance in the treatment of AKI patients. Our study group, from the Botucatu School of Medicine, Brazil, demonstrated that, with careful thought and planning, critically ill AKI patients can be successfully treated with PD[13,14,16,19,21,31]. To overcome some of the classic limitations of PD use in AKI (such as a low rate of ultrafiltration [UF], high chance of infectious and mechanical complications, and no metabolic control) we proposed the use of cyclers, flexible catheters, continuous therapy (24 h), and high volumes (HV) of dialysis fluid.

We assessed the efficacy of HVPD in a prospective study of 30 consecutive AKI patients[16]. PD was performed using a Tenckhoff catheter, 2 L exchanges, and 35–50 min dwell times. The prescribed Kt/V value was 0.65 persession, the duration of each session was 24 h, and a total dialysate volume of 36–44 L/day was used. HVPD was effective in the correction of blood urea nitrogen (BUN), creatinine, bicarbonate, and fluid overload. Weekly Kt/V was 3.8 ± 0.6 and the mortality was 57%.

Five years later, we performed another prospective study on 204 AKI patients treated with HVPD (prescribed Kt/V=0.60/session)[27]. Sepsis was the main cause of AKI (54.7%) followed by heart failure (24.7%). BUN and creatinine levels stabilized after four sessions to approximately 50 mg/dL and 4 mg/dL, respectively. Weekly-delivered Kt/V was 3.5 ± 0.68 and the mortality rate was 57.3%. Older age and sepsis were identified as risk factors for death. Persistence of urine output, increases of 1 g/day in nitrogen balance (NB), and achieving 500 mL/day UF after three sessions were identified as favorable prognostic factors. We concluded that HVPD is effective in selected patients. However, if after three sessions, UF is low or NB is negative, substitution or addition of HD should be considered. There were mechanical complications in 7.3% of AKI patients treated with HVPD and 12% of patients had infectious complications (peritonitis). Change of the dialysis method occurred in 13.3% of patients because of refractory peritonitis or mechanical complications (leakage or UF failure).

Dialysis dose adequacy in AKI is a controversial subject and there are very limited data on the effect of PD dose on AKI. Solute clearance in PD is limited by dialysate flow, membrane permeability, and surface area in contact with dialysate. Exchanges of 2 L lasting approximately 1 h can achieve a saturation of the spent dialysate in the range of 50%. This means that over 24 h, a daily Kt/V of 0.5 can be achieved in a patient with a body weight between 60 and 65 kg[22-24].

We performed a trial of 61 septic AKI patients randomized to receive higher (n = 31) or lower (n = 30) intensity PD therapy (prescribed Kt/V of 0.8/session vs. 0.5/session). The two groups had similar mortality after 30 days (55% vs. 53%, $p = 0.83$). We concluded that increasing the intensity of continuous HVPD therapy does not reduce mortality and does not improve control of urea, potassium, and bicarbonate levels[35].

According to the ISPD guidelines: PD for AKI recommendations, where resources permit, targeting a weekly Kt/V urea of 3.5 provides outcomes comparable to that of daily HD; targeting higher doses does not improve outcomes. This dose may not be necessary for many AKI patients and targeting a weekly Kt/V of 2.1 may be acceptable[4].

The second question to consider is whether PD is comparable to other dialysis methods in AKI patients. The answer to that question is neither simple nor currently complete. The various modalities present advantages and disadvantages under specific circumstances and these therapies should therefore be considered more as a continuum than as a series of modalities to be compared. Few studies have

compared PD with other dialysis methods in AKI patients and reports conflict with regard to efficacy and cost. Phu et al.[27] compared intermittent PD with continuous RRT and demonstrated a worse outcome in patients treated with PD. Such reports should not be underestimated, although specific factors (such as the use of rigid catheters, manual exchanges, a too-short dwell time [15 min], and no dialysis dose quantification) might be involved.

A randomized study performed by our group in 120 AKI patients compared HVPD versus daily iHD[21]. Baseline characteristics were similar in both groups, which included older patients (mean age > 60 years), patients with a high APACHE II score, and patients using vasoactive drugs (> 60%). Both RRT modalities achieved metabolic and acid-base control. Mortality did not differ significantly between the two groups (58% versus 53%). Renal recovery was similar for both modalities, but HVPD was associated with a significantly shorter time to recovery (7.2 ± 2.6 versus 10.6 ± 4.7 days).

George et al.[36] performed a randomized study to compare continuous venovenous hemodiafiltration (CVVHDF) and PD in critically ill patients. No difference was observed in the correction of metabolic parameters and fluid overload. Urea and creatinine clearances were higher and fluid correction was faster with CVVHDF. The mortality rates in the two study groups were similar. Unfortunately, the procedures were performed at different technological levels to the detriment of PD, in which rigid catheters, locally available PD fluids, and manual exchanges were used.

In another prospective study, we compared the effect of HVPD against prolonged HD (PHD) on AKI patients' outcome[37]. The PHD and HVPD groups were similar in gender, severity, and aetiology of AKI. There was a trend toward statistical difference regarding the presence of sepsis (62.3% in PHD group versus 44.9% in HVPD group, $p = 0.054$). Delivered Kt/V and UF were higher in PHD group and there was no difference between the two groups in mortality and recovery of kidney function, or need for chronic dialysis.

In a study from Saudi Arabia, evaluating the outcomes of critically ill patients with AKI-requiring dialysis, 125 patients were randomized to receive either CVVHDF (n = 62), or automated PD (n = 63). Both groups had similar baseline characteristics and PD treatment consisted of 25 L/day (2.0 L in each fill, with 70% tidal volume). Bicarbonate/lactate buffered low glucose degradation product PD solutions were used. Those treated with PD had superior 28-day survival compared to those on CVVHDF (69.8% vs. 46.8%, $p < 0.01$). Secondary outcomes, including median time to resolution of AKI, ICU stay, and infectious complications were all statistically shorter/lower in the PD group[20].

Two systematic reviews[11,12] concluded that there is currently no evidence to suggest significant differences in mortality between PD and extracorporeal blood purification in AKI and that there is a need for high-quality evidence in this important area.

The Brazilian group published the largest cohort study providing patient characteristics, clinical practice, patterns, and their relationship to outcomes in a developing country[38]. Its objective was to describe the main determinants of patient and technique survival, including trends over time of PD treatment in AKI patients. For comparison purposes, patients were divided into two groups according to the year of treatment: 2004–2008 and 2009–2014. A total of 301 patients were included, though 51 were transferred to HD (16.9%) during the study. The main cause of technique failure (TF) was mechanical complication (47%) followed by peritonitis (41.2%). There was a change in TF during the study period; patients treated during 2009–2014 had a relative risk (RR) reduction of 0.86 (95% CI, 0.77-0.96) compared with patients treated between 2004 and 2008, and three independent risk factors were identified: period of treatment between 2009 and 2014, sepsis, and age >65 years.

During the study, there were 180 deaths (59.8%). Compared with patients treated from 2004–2008, patients treated at 2009–2014 had a RR reduction of 0.87 (95% CI, 0.79–0.98). The independent risk factors for mortality were sepsis, age >70 years, Acute Tubular Necrosis Individual Severity Score (ATN-ISS) >0.65, and positive fluid balance (FB). In conclusion, we observed an improvement in patient survival and TF between the two time periods, even after correction for several confounders and using a competing risk approach.

Table 3. Advantages and disadvantages of different catheter implantation techniques

	Advantages	Disadvantages
Percutaneous (bedside)	– Can be performed at bedside allowing rapid initiation of dialysis – Physician or nurse can be trained to perform the procedure	– Risk of bowel or bladder injury – Not suitable in patients with previous midline surgical or risk of adhesions
Open Surgical	– Available in most centres – Cost of consumables lower than laparoscopy	– Needs surgical scheduling, where available theatre time at a premium
Laparoscopy	– Lower incidence of leak – Ability to perform adjunctive procedures such as rectus sheath tunnelling and omentopexy, etc. – Ability to place the catheter in the pelvis under vision	– Skilled personnel necessary – High cost of consumables

PERITONEAL DIALYSIS ACCESS PLACEMENT AND PRESCRIPTION FOR AKI

Flexible over rigid PD catheters are preferred allowing for higher flow rates of dialysate with a lower risk of leak, facilitating rapid escalation in dwell volumes, which is particularly important in catabolic patients[4,39]. In addition, infection and bowel perforation risks are lower with flexible catheters[4,39]. The method of PD catheter insertion (laparoscopic vs. percutaneous) should consider local experience, available resources, and the patient's surgical history and clinical status. Laparoscopic surgeries are usually not possible in critically ill patients in whom general anesthesia is often not tolerated. In such cases, having trained interventionalists (nephrologists/radiologists/surgeons) who can percutaneously insert PD catheters can facilitate rapid PD access placement. Table 3 shows the advantages and disadvantages of different catheter implantation techniques.

The PD prescription for AKI therapy should be individualized depending on the metabolic and volume status of the patient. No consensus exists on the optimal PD dose in AKI patients. Based on studies from Brazil, India, and Thailand, the ISPD suggests that a weekly Kt/V urea of 2.1 may be acceptable for most patients with AKI. Furthermore, higher Kt/V might be needed in hypercatabolic patients[4,25,35].

We have prepared a flowchart of the practical aspects of prescribing, delivering, and monitoring the HVPD in AKI patients (Fig. 1).

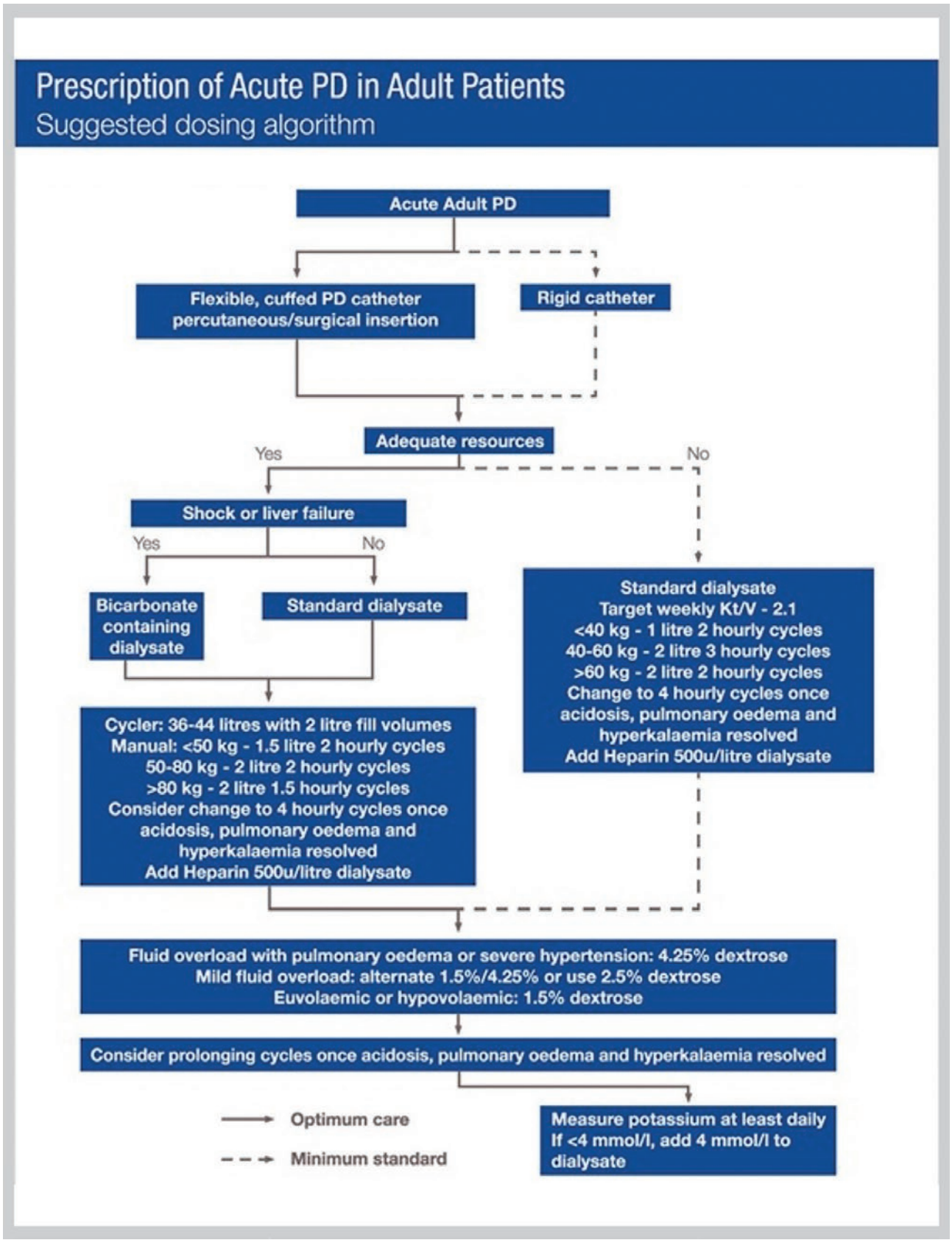
COMPLICATIONS RELATED TO PERITONEAL DIALYSIS TREATMENT

Mechanical and infectious PD complications are major concerns. Peritonitis occurring in patients with AKI using PD as a modality of RRT can lead to very poor outcomes, and older studies have reported a frequency as high as 40%[13,14,21]. With better catheter implantation techniques and automated methods, the incidence of peritonitis was reduced and the risk of infection in PD was similar to other extracorporeal blood purification for AKI[13,14,40]. The most recent studies related peritonitis levels from 12% to 15%, and fungi and Pseudomonas aeruginosa were the most common agents[13,14,21,40].

Leak and tip catheter migration are the main mechanical complications and can occur in 12-20% of AKI patients treated by PD[38-42]. Leak risks can result from patient factors (i.e., diabetes, obesity chronic steroid use) and modified by PD catheter insertion technique[41,42]. Lower initial fill volumes (20 mL/kg) and performing PD while supine may decrease the risks of peri-catheter leaks both of which lower abdominal pressure. However, the risk of leak following the use of acute high-volume PD of 2.0L in previous studies from Brazil was low and did not result in interruption of therapy[38,39].

The main metabolic complications are hyperglycemia and hypokalemia. The high glucose concentrations in peritoneal dialysate may cause hyperglycemia, even in non-diabetic patients. This is easily correctable

Figure 1. Acute PD dosing guidelines-adapted from ISPD guidelines[4].



through intravenous or intraperitoneal administration of insulin. In dialysate, there is no potassium and hypokalemia can be avoided adding potassium to bags[31,38,39].

PERITONEAL DIALYSIS IN SPECIAL POPULATIONS WITH AKI

Type 1 cardiorenal syndrome

Cardiorenal syndrome (CRS) type 1 is characterized by an acute heart disorder leading to AKI[43,44]. Hemofiltration has been used for more than 30 years, despite inconclusive evidence of its advantages[45-48].

The rationale for PD use in CRS type 1 is multiple. It offers gentle UF and is not associated with myocardial stunning. There is minimal impact on hemodynamics that would theoretically result in a lower degree of neurohumoral stimulation and in slower decline or faster recovery in renal function, factors known to be associated with survival[49-51]. Because it is a daily and continuous treatment, PD also allows for effective continuous solute clearance, including sodium and potassium, allowing better up-titration of pharmacological treatment for heart failure.

Several uncontrolled PD studies have so far reported favorable results for patients with type 2 CRS in terms of hospitalization rates and duration, functional classification of heart failure, and quality of life[52,53]. However, only two studies have evaluated PD use in type 1 CRS patients.

Ponce et al. evaluated 64 type 1 CRS patients treated by HVPD (prescribed Kt/V = 0.50/session), using a flexible catheter and cycler. The mean age was 68.8 ± 15.4 years, 54.7% needed intravenous inotropic agents and/or intravenous vasodilators, 31.2% were on mechanical ventilation, acute coronary syndrome (ACS) was the main cause of acute disease heart failure (ADHF) 48.3%, median left ventricular ejection fraction was 38% and the main dialysis indications were uremia and hypervolemia. Blood ureic nitrogen and creatinine levels stabilized after 4 sessions at around 50 and 4 mg/dL, respectively. Negative FB and UF increased progressively and stabilized around 2.6 L and -2.5 L/day, respectively. Weekly delivered Kt/V was 3.0 ± 0.42, and 32.8% died. There was a significant difference between the survivors (S) and non-survivors (NS) in age (71.4 ± 15.7 vs. 63.6 ± 17.6, $p < 0.001$), main diagnosis of ADHF (ACS: 76.2 vs. 34.8%, $p = 0.04$), mechanical ventilation (52.4 vs. 20.1%, $p = 0.03$), fluid overload (FO) at predialysis moment (52.4 vs. 25.6%, $p = 0.04$), and FB and UF from the 2nd to 5th dialysis session. In conclusion, HVPD treatment was effective in CRS type 1 patients, allowing adequate metabolic and fluid control. Age, ACS, FO, and positive FB after 2 HVPD sessions were higher in NS patients.

Al-Hwiesh et al. performed a randomized study with 88 type 1 CRS patients treated by UF versus PD[54]. Inclusion criteria were at least 2+ peripheral edema, jugular venous pressure ≥ 10 cm of water, ascites, pulmonary edema, or pleural effusion on chest radiography. Loop diuretics, IV vasodilators, and positive inotropic agents were discontinued during the intervention. Patients assigned to TPD44 were treated using a Tenckhoff catheter inserted by nephrologists, 20–25 L/day, using PHYSIONEAL 1.36%–2.27% and occasionally 3.86%, 1.5 to 2.0 L/cycle and tidal volume of 70%. Dwell time between 90 and 120 min, 12–14 cycles per day, PD session lasted 24 h. Patients assigned to UF[44] were treated using PRISMA® - SCUF, CVC in the femoral or internal jugular vein, QB from 100 to 170 mL/min and the UF rate from 75 to 120 mL/h. UF rate adjustments and duration of therapy were driven by clinical and hemodynamic goals by the caring nephrologists and cardiologists. The use of tidal PD was superior to UF therapy for the preservation of kidney function, improvement of cardiac function, rehospitalization, and death. UF was associated with a higher rate of adverse events. The available data indicate PD as an effective therapeutic option for fluid removal and metabolic control in type 1 CRS.

ACUTE ON CHRONIC LIVER FAILURE PATIENTS

AKI is a common complication of acute on chronic liver failure (ACLF), occurring in up to 20% of hospitalized cirrhotic patients[55]. The main reasons for the development of AKI in patients with decompensated cirrhosis are infections, hypovolemia associated with bleeding or the use of diuretics, nephrotoxicity (drug-induced or contrast-induced nephropathy), hepatorenal syndrome (HRS), and parenchymal nephropathy[56-58].

Liver transplantation is the only treatment modality for the reversal of AKI associated with HRS (HRS-AKI) in the cirrhotic setting, while KRT is a bridging therapy aimed at keeping the patient alive until receiving the graft[59-65]. The assessment of prognosis, eligibility for liver transplantation, and advanced stages of cirrhosis should be considered before KRT to avoid futile treatments[61-63].

Acceptable KRT methods are iHD or PHD, continuous hemofiltration or continuous hemodiafiltration (CRRT), and PD.

The choice of the dialytic method is critical in decompensated cirrhotic patients. Hypotensive reactions and blood clotting abnormalities are more frequent during hemodialysis (HD) in cirrhotic patients than in patients with an intact liver. The most important limiting factor of iHD is hemodynamic instability and PHD; CRRT and PD may be better tolerated[62-65]. PD is also able to remove ascites fluid, does not increase the number of complications, and does not expose patients to anticoagulants[66].

Ponce et al.[67] performed a study that explored the role of PD in acute-on-chronic liver disease (ACLD) in relation to metabolic and fluid control and outcome. Fifty-three patients were treated by PD (prescribed Kt/V = 0.40/session), with a flexible catheter, tidal modality, using a cycler and lactate as a buffer. The mean age was 64.8 ± 13.4 years, the model of end-stage liver disease (MELD) was 31 ± 6, 58.5% were in the intensive care unit, 58.5% needed intravenous inotropic agents including terlipressin, 69.5% were on mechanical ventilation, alcoholic liver disease was the main cause of cirrhosis and the main dialysis indications were uremia and hypervolemia. Blood urea and creatinine levels stabilized after four sessions at around 50 and 2.5 mg/dL, respectively. Negative FB and UF increased progressively and stabilized around 3.0 L and −2.7 L/day, respectively. Weekly delivered Kt/V was 2.7 ± 0.37, and 71.7% of patients died. Five factors met the criteria for inclusion in the multivariable analysis.

Logistic regression identified as risk factors associated with AKI in ACLD patients: MELD (OR = 1.14, CI 95% = 1.09-2.16, p = 0.001), nephrotoxic AKI (OR = 0.79, CI 95% = 0.61-0.93, p = 0.02), mechanical ventilation (OR = 1.49, CI 95% = 1.14-2.97, $p < 0.001$), and positive FB after two PD sessions (OR = 1.08, CI 95% = 1.03-1.91, p = 0.007). These factors were significantly associated with death. In conclusion, our study suggests that careful prescription may contribute to providing adequate treatment for most ACLF patients without contraindications for PD use, allowing adequate metabolic and fluid control, with no increase in the number of infectious or mechanical complications. MELD, mechanical complications, and FB were factors associated with mortality, while nephrotoxic AKI was a protective factor. Further studies are needed to better investigate the role of PD in ACLF patients with AKI.

NEUROCRITICAL PATIENTS

AKI occurs frequently in the neurocritical intensive care unit and is associated with greater morbidity and mortality. In this scenario, AKI alters the kidney–brain axis, exposing patients who receive habitual dialytic management to greater injury[68,69].

AKI and its treatment, including AKRT, can expose patients to a secondary greater brain injury. Various therapies have been designed to mitigate this risk. Priority has been placed on the use of continuous over intermittent renal replacement therapies, but there is still not enough evidence to recommend continuous therapy over intermittent therapy.

Ponce et al. performed a study (not published) that explored the role of PD in neurocritical AKI patients in relation to metabolic and fluid control, complications related to PD and outcome. Fifty-eight neurocritical AKI patients were treated by PD (prescribed Kt/V = 0.40/session), using a flexible catheter and a cycler and lactate as a buffer. The mean age was 61.8 ± 13.2 years, 65.5% were in the intensive care unit, 68.5% needed intravenous inotropic agents, 72.4% were on mechanical ventilation, APACHE II was 16 ± 6.67, the main neurological diagnosis were stroke (25.9%) and intracerebral hemorrhage (31%). Ischemic acute tubular necrosis was the most common cause of AKI (51.7%), followed by nephrotoxic ATN AKI (25.8%), The main dialysis indications were uremia and hypervolemia. Blood urea and creatinine levels stabilized after four sessions at around 48 ± 11 mg/dL and 2.9 ± 0.4 mg/dL, respectively. Negative FB and UF increased progressively and stabilized

around 2.1±0.4 L /day. Weekly delivered Kt/V was 2.6 ± 0.31. The median number of HVPD sessions was 6 (4-10). Peritonitis and mechanical complications are not frequent (8.6% and 10.3%, respectively). Mortality rate was 58.6%. Five factors met the criteria for inclusion in the multivariable analysis. Logistic regression identified as factors associated with death in neurocritical AKI patients: age (OR = 1.14, CI 95% = 1.09-2.16, p= 0.001), nephrotoxic AKI (OR = 0.78, CI 95% = 0.69-0.95, *p* = 0.03), mechanical ventilation (OR = 1.54, CI 95% = 1.17-2.46, p= 0.01), intracerebral hemorrhage as main neurological diagnoses (OR = 1.15, CI 95% = 1.09-2.11, *p* = 0.03), and negative FB after two PD sessions (OR = 0.94, CI 95% = 0.74-0.97, *p* = 0.009). The authors concluded that careful prescription may contribute to providing adequate treatment for most neurocritical AKI patients without contraindications for PD use, allowing adequate metabolic and fluid control, with no increase in the number of infectious, mechanical, and metabolic complications. Mechanical ventilation and intracerebral hemorrhage were factors associated with mortality, while nephrotoxic AKI and negative FB were protective factors. Further studies are needed to investigate better the role of PD in neurocritical patients with AKI.

CONCLUSIONS

PD is a simple, safe, and efficient way to correct metabolic, electrolytic, acid-base, and volume disturbances generated by AKI; it can be used as an AKRT modality to treat AKI, either in or out of the intensive care unit setting. We have recently observed an improvement in patient and technique survival over the years even after correction for several confounders.

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