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Peritoneal dialysis in the intensive care setting: historical and contemporary insights after the COVID-19 pandemic

(La dialyse péritonéale en soins intensifs : perspectives historiques et contemporaines après la pandémie de COVID-19)

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Summary

Peritoneal dialysis (PD) has been used since 1946 as a treatment for acute renal injury (AKI). Despite a decline in its use in favor of extracorporeal techniques in high-income countries, it is experiencing a resurgence of interest, thanks in particular to its adaptability to health crises. The COVID-19 pandemic has highlighted its strategic and complementary role, particularly in intensive care, where it can be used to compensate for the saturation of hemodialysis (HD) and continuous renal replacement therapy (CRRT) resources. In addition, recent studies and randomized controlled trials suggest that PD offers survival and renal recovery outcomes comparable to HD or continuous hemofiltration.

However, PD remains underused in intensive care, hampered by negative perceptions and organizational barriers, and perpetuated by a lack of general exposure to the technique in intensive care units, not only among intensivists but also among nephrologistsThe variability in the adoption of PD at the international and regional levels reflects these cultural disparities, with low-resource countries or countries with a higher prevalence of PD (China, Mexico, Australia) often favoring it for its logistical simplicity and lower cost.

Through a non-exhaustive review, this article examines the current place of PD in intensive care units, the associated clinical outcomes, the various barriers to its wider use, and potential solutions to promote the adoption of PD care for patients with renal failure (acute or chronic) hospitalized in intensive care units.

Keywords: COVID-19, emergency peritoneal dialysis, chronic renal failure, acute renal failure, extra renal purification, CVVH, CVVHD, intermittent hemodialysis, intensive care unit

Résumé

La dialyse péritonéale (DP) est utilisée depuis 1946 comme traitement de l'insuffisance rénale aiguë (IRA). Malgré un recul face aux techniques extracorporelles dans les pays à hauts revenus, elle connaît un regain d'intérêt, grâce notamment à son adaptabilité en situation de crise sanitaire. La pandémie de COVID-19 a rappelé son rôle stratégique et complémentaire, notamment en réanimation pour pallier la saturation des ressources en hémodialyse (HD) et en thérapies continues de suppléance rénale (TSCR). De plus, des études récentes et des essais contrôlés randomisés suggèrent que la DP offre des résultats en termes de survie et de récupération rénale comparables à l'HDi ou l'hémofiltration continue.

Cependant, la DP reste sous-utilisée en réanimation, freinée par des perceptions négatives et des barrières organisationnelles, entretenues par un manque d'exposition générale à la technique en unité de réanimation, mais aussi auprès des néphrologues. La variabilité d'adoption de la DP au niveau international et au niveau régional reflète ces disparités culturelles, les pays à faibles ressources ou à plus haute prévalence pour la DP (Chine, Mexique, Australie) privilégiant souvent celle-ci pour sa simplicité logistique et son moindre coût.

A travers une revue non exhaustive, cet article examine la place actuelle de la DP en unité de réanimation, les résultats cliniques associés, les différentes barrières liés à son utilisation plus large ainsi que les solutions potentielles pour favoriser l'adoption de la DP dans la prise en charge des patients insuffisants rénaux (aigus ou chroniques) hospitalisés en unité de réanimation.

Mots-clés : COVID-19, dialyse péritonéale urgente, insuffisance rénale chronique, insuffisance rénale aiguë, épuration extrarénale, CVVH, CVVHD, hémodialyse intermittente, unité de réanimation

Introduction

In high-income countries, such as those in Europe, intermittent hemodialysis (iHD) and continuous renal replacement therapies (CRRT) are the predominant renal replacement modalities for the management of grade 3 acute kidney injury (AKI) or stage 5 chronic kidney disease (CKD) in critically ill patients admitted to intensive care units (ICUs). [1] However, data suggest that peritoneal dialysis (PD) produces results comparable to those of iHD and CVVHD in critically ill patients with AKI. [2] Indeed, this method of renal replacement therapy, which is well established in elective and stable situations, has the main advantage of better preserving residual renal function and vascular capital. [2] However, it remains rarely used, despite international recommendations that advocate it as an appropriate alternative to CRRT. [3]

The low prevalence of PD is primarily due to historical and political-economic factors, followed by local and regional cultural and medical organizational factors ("center effect" or "practice patterns"). In high-income countries, its use for patients with chronic renal failure has declined in favor of extracorporeal techniques, while it remains prevalent (>30%) in many regions with fewer resources (Africa, India), but also in certain regions that have adopted an economic policy favorable to PD (China, Korea, Japan, Thailand, Australia, Brazil, Scandinavian countries), [4] as well as in pediatrics (up to 60–70% use depending on the series). [5] As proof, before the 1980s and the rapid growth of HD centers in Europe following encouraging political directives, PD (and home dialysis in general) was the "default" option. HD, considered more effective for the rapid removal of uremic toxins and the reduction of volume overload, gradually supplanted PD. A decline in PD, combined with a loss of local expertise, has perpetuated a vicious circle, consolidating an organizational culture largely centered on HD, including in intensive care. [6] Despite these cultural barriers, PD remains applicable in a large proportion of critically ill patients hospitalized in the ICU. [7]

The COVID crisis has been a major turning point, putting an end to many preconceived ideas about PD and highlighting the numerous limitations of HD supremacy in health crises. During this period, PD demonstrated its strategic value by supplementing HD resources that quickly became saturated due to a lack of machines, supplies, or staff [4]. Since then, numerous articles have discussed the initiation of PD in emergencies for patients with COVID-19 and stage 3 AKI, intensifying interest in this technique in acute and/or critical clinical contexts. This approach has also been cited as a potential solution for better controlling the costs of dialysis-related care, particularly in the context of an aging population.

Through a narrative and non-exhaustive review, this article provides an overview of the current place of PD in critically ill renal failure patients and offers a summary of good clinical and logistical practices to promote its adoption in our intensive care units in "high-income" countries.

Peritoneal dialysis in intensive care units

Peritoneal dialysis in intensive care in context

PD in intensive care units (ICUs) is used in two main clinical situations: emergency initiation of PD (within 72 hours of PD catheter placement) for severe AKI (or CRF with late presentation) in a patient not already on dialysis (emergency PD) and continuation of PD as a chronic modality in patients already on dialysis (chronic PD continuing in a "critical" situation).

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Acute renal failure in intensive care

In intensive care, AKI is mainly linked to shock, severe sepsis, multiple organ failure, and drug-induced nephrotoxicity. [1] AKI is associated with substantial mortality in patients admitted to the ICU. [8–11] Although these patients are more frequently admitted to intensive care units, they also have an increased risk of morbidity and mortality compared to those with preserved renal function. [12]

"Emergency" peritoneal dialysis in intensive care

In patients with AKI requiring extra renal purification, PD may be considered. This is referred to as "urgent PD" (urgent start peritoneal dialysis or USPD). When initiating PD in an acute setting, a healing period ("break-in") after placement of the intraperitoneal catheter is normally desirable. This period, which can last up to 72 hours, reduces the risk of dialysate leakage, particularly along the percutaneous tunnel. The catheter is usually inserted percutaneously under local or regional anesthesia, without general anesthesia, and can be performed by an experienced nephrologist, interventional radiologist, or surgeon, preferably under ultrasound guidance to avoid visceral perforation or puncture of the epigastric artery. However, in certain situations of acute renal failure requiring immediate treatment, this healing time is not possible. PD can then be started within 24 hours of catheter implantation ("very urgent start" or "emergency start"), despite a slightly increased risk of mechanical complications, particularly leaks. In these situations (urgent or very urgent start), an appropriate prescription strategy is essential to limit mechanical complications while ensuring adequate purification. Gradually increasing small infusion volumes reduces the risk of dialysate leakage and limits intra-abdominal pressure. To maintain a sufficient dialysis dose despite these low volumes, the regimen is based on increased numbers of short, repeated cycles (45 to 120 minutes), up to 12 exchanges per day, ideally via an automated cycler in the supine position.

Physiologically, this approach meets several requirements. Short cycles combined with highly hypertonic solutions (with a high percentage of glucose) increase the risk of sodium sieving, i.e., initial ultrafiltration consisting mainly of free water, low in solutes. However, in urgent PD situations, it is preferable to achieve ultrafiltration comprising water and solutes, which is more effective for volume management and correction of metabolic disorders. Adjusting the volume, cycle duration, and osmolarity of the solutions therefore aims to optimize this balance between mechanical safety and purification efficiency *(Table 1)*. [3] If the patient's metabolic (or catabolic-uremic) state allows it, "dry" periods (intermittent PD where the abdominal cavity is empty) are recommended to promote healing of the percutaneous catheter pathway. [3]

Data on USPD highlight an increased incidence of minor mechanical complications, with no significant difference in the survival of the technique or transfer to HD. [14–17] In a retrospective study, patients started within 48 hours required more catheter repositioning than those started between 2 and 13 days. [13] However, more robust clinical data from a randomized controlled trial will demonstrate favorable outcomes for USPD compared to temporary "urgent start" HD in patients transitioning to PD. [18]
In line with these observations, experience with late-stage CKD patients ("crashlanders") without vascular access also supports the safety and efficacy of urgent PD initiation as an alternative to temporary HD via central venous catheter. Available studies and systematic reviews indicate that urgent initiation of PD is associated with an increased risk of mechanical complications,

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particularly dialysate leaks, without increasing the risk of infection or short- or long-term mortality compared to conventional PD. [19] [20] Technical survival and patient survival remain comparable between the two modalities, while the risk of bacteremia appears to be significantly lower in urgent PD than in catheter HD. [21–23] Although no specific data are available for AKI, the principle of urgent initiation is considered safe by extrapolation from the results obtained in CRF. [24, 25] Clinical experience reported, notably by Lobbedez and Povlsen, confirms the feasibility and safety of this strategy in crashlanders, provided that close monitoring and an experienced team are available. [19]

Table I. Peritoneal dialysis in intensive care: advantages, challenges, and solutions

Good indications – Advantages	
- No central venous access required – limits the risk of thrombosis-bacteremia - No systemic anticoagulation required – limits the risk of bleeding - No extracorporeal circuit – limits the risk of clotting in CRRT/HDi tubing - UF and gentle solute clearance, better hemodynamic tolerance in cases of instability or for cardio-renal patients. - Less burden on nursing staff (no need for highly qualified personnel at all times) - Easier learning technique for nursing staff - No need for an ultra-pure water supply - Lower cost (DPCA>DPA) but dependent on the price of consumables (specific to each country)	
Limitations – Challenges	**Solutions**
Insufficient UF and/or less predictable water balance	Use of hypertonic solutions, short stasis times <120 minutes, icodextrin/bimodal UF, APD
Clearance failure during hypercatabolic states	Use of high volumes via cycler (12–25 L), hybrid therapy with *CVVHF*/HDi
Impact of IPP on ventilatory mechanics and residual functional capacity	- PaO2/FiO2 monitoring - IPP monitoring (bladder catheter) - Use of volumes <2.5L
Mechanical complications (leakage or KT flow restriction)	- Gradually increasing dialysate volumes (<1.5L in the first 72 hours) - Prophylactic laxatives - Colonic preparation before PD catheter placement - Regular monitoring of tubing (fibrin, heparin 500 U/L)
Emergency insertion of PD KT at the bedside without GA	- Acquisition of expertise in percutaneous placement by nephrologists, interventional radiologists, or surgeons
Prone position in cases of severe hypoxemia/ARDS	- Use of hybrid HDi/CVVH/CVVHD therapies during prolonged prone positions
"Masked" peritonitis – infection of the exit site	- Daily measurement of nucleated elements in the dialysate - Daily review and disinfection of the exit site - Mycobacteria culture (antibiotic therapy)

CRRT: continuous renal replacement therapy; HDi: intermittent hemodialysis; UF: ultrafiltration; CAPD: continuous ambulatory peritoneal dialysis; APD: automated peritoneal dialysis; CVVHF: continuous veno-venous hemofiltration; IPP: intraperitoneal pressure; KT: catheter; ARDS: acute respiratory distress syndrome; PD: peritoneal dialysis; GA: General anaesthesia.

"Chronic PD" in intensive care

The second situation concerns patients with PD who are admitted to intensive care, for example, following septic shock, respiratory distress, or major surgery. In this case, it is often possible to maintain PD rather than inserting a vascular catheter, which avoids systemic anticoagulation

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and reduces the risk of bacteremia. However, certain circumstances, such as complex abdominal surgery or severe peritonitis, may require temporary use of HD or CRRT until the abdominal problem is resolved. The decision must then be made collectively by nephrologists and intensive care specialists, weighing the benefits and risks. Continuity of care using a dialysis technique familiar to the patient and the healthcare team can, in some cases, limit errors and facilitate daily management, especially in the context of excessive workload in intensive care.

Clinical results of peritoneal dialysis in severe AKI in the intensive care unit

Clinical outcomes from the scientific literature

While large multicenter trials such as AKIKI have helped to determine the optimal time to initiate extra renal clearance in intensive care units, [26] the majority of these studies excluded PD, highlighting the need for data specific to this modality. Although dialysis societies [3] position PD as a method that is as valid as HD in the treatment of AKI in various contexts, the efficacy (and predictability) of PD in terms of solute clearance and ultrafiltration for the management of these patients seems controversial among nephrologists and intensive care physicians. Several randomized controlled single-center studies and meta-analyses have highlighted the comparability of its results with those of HD or CRRT, provided that experienced teams are available and certain limitations on the application of PD compared to HD are respected. [6, 27, 28]

Meta-analyses, including a 2017 Cochrane systematic review, involving six randomized controlled trials and 487 patients, mainly from resource-limited countries, indicate that PD is not inferior to extracorporeal HD methods (conventional HD, daily HD, or CVVHDF) in the management of stage 3 AKI in terms of patient survival and renal recovery at 1 month. [28] It should be noted that only one study, the oldest (including patients with AKI from 1993–1998), conducted in Vietnam [29] and subject to numerous biases, had to be stopped prematurely due to a significant survival benefit in favor of extracorporeal purification techniques such as CVVHDF. The other five studies, all single-center and slightly more recent, demonstrated the non-inferiority of continuous PD at high doses (24 hours/day, 25–44 L/day) compared to HDi/CVVHDF with respect to hard endpoints such as 1-month patient survival, as well as other secondary endpoints such as 1-month renal recovery (1-month survival without dialysis), fluid balance (daily UF between 1 and 3 L, comparable with both techniques although with a lower trend in PD), and the rate of complications related to the technique used (mainly infections, hypokalemia, and hemorrhage). [30,31,31–33] A more recent Thai multicenter trial from 2024, including 157 patients suffering mainly from stage 3 septic AKI, confirmed comparable survival and renal recovery at 1 month between conventional HDi and high-dose continuous PD (18–24 L per day), with a comparable weekly UF rate of around 3,000 mL. Better hemodynamic tolerance with less intradialytic hypotension was also reported in the PD group, but this was offset by a need for more frequent supplementation for hypokalemia. [30]

In these studies, it should be noted that dialysis prescriptions were very heterogeneous, with daily exchange volumes generally very high, between 18 and 44 liters, reflecting the significant metabolic needs of these stage 3 ESRD patients. Furthermore, most of these randomized trials were conducted in low-income countries with a higher prevalence of PD (Brazil, Thailand, India, Vietnam), with favorable technical expertise and organizational culture, which may have led to a bias in favor of PD. The applicability of these results therefore remains to be demonstrated in our industrialized European countries. [34]

Advantages and benefits of peritoneal dialysis in patients admitted to the ICU

PD can offer significant advantages in the specific context of patients with renal failure admitted to intensive care *(Table 1)*. [34] It avoids the risks associated with central venous catheters and extracorporeal blood circuits, such as infections, bacteremia, or catheter or circuit thrombosis (prothrombotic state), and does not require systemic anticoagulation, which is a key advantage for patients at high risk of bleeding or, conversely, coagulopathy. Finally, it is also better tolerated hemodynamically in certain unstable or cardio-renal patients, which may promote faster renal recovery according to some studies. [5, 7, 27, 35] Its benefits are particularly evident in patients with advanced heart failure or on ECMO (extracorporeal membrane oxygenation), for whom hemodynamic tolerance is a key point, as well as in certain cases of multiple organ failure where vascular access is complex. Numerous studies and experience reports [2,36,37] highlight the feasibility of PD in these situations, provided that organizational obstacles are overcome and trained teams are available.
The main advantages of PD in the intensive care setting also lie in its logistical implementation, which requires less infrastructure (no need for a system to supply osmosis water and discharge it into the sewer system), generally lower costs (supplies, dialysis machine and purification system, staff), and ease of technical learning for healthcare staff compared to HD/CRRT. [38] These advantages are particularly valuable in cases of limited access to HD (low-income countries) or situations of shortages such as during a pandemic (COVID-19) or natural disasters.

Limitations and potential complications of peritoneal dialysis in critically ill patients

However, the use of PD in critically ill patients has absolute or relative contraindications that limit its more widespread use in ICUs, which should be noted: recent abdominal surgery with a risk of peritoneal breach (laparotomy, cesarean section and other gynecological surgery, urological surgery, laparoscopy, retroperitoneal surgery), carcinosis, active peritonitis, uncontrolled intra-abdominal infection or inflammatory process, uremic pericarditis or life-threatening hyperkalemia, pulmonary edema with respiratory failure, and finally, drug intoxication, [3, 7] a combination of situations that are otherwise common in intensive care units *(Table 1)*. It should be noted that non-biocompatible solutions buffered with lactate can “artificially” raise lactate levels without necessarily reflecting tissue hypoperfusion, but rather a delay in hepatic metabolism. [7, 39]

- A possible impact on respiratory mechanics

One of the main challenges of using PD in intensive care is its effect on respiratory biomechanics, particularly in mechanically ventilated patients. Several studies have shown that the increase in intra-abdominal pressure (IAP) induced by the instillation of 1.5 to 2 L of dialysate (with an increase in IAP of 0.5 to 10 cm H_2O) does not cause significant deterioration in respiratory compliance, resistance, or oxygenation index, provided that the intraperitoneal volume and patient position are adjusted to maintain controlled intra-abdominal pressure. Ponce et al. recommend the use of short cycles and limited exchange volumes to prevent diaphragmatic compression, [5] while Almeida et al. confirmed that a volume of 2 L does not reach a critical threshold likely to alter respiratory mechanics in intubated patients. [31]

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In non-intubated patients, data are more limited; studies conducted in healthy volunteers undergoing PD did not show any changes in FEV1/FVC or diffusion capacity, although a reduction in expiratory reserve volume and residual functional capacity was observed. [32,33] In patients with fragile respiratory balance, dialysate instillation could theoretically compromise this balance, particularly in the pre-intubation phase. [2, 7]

The experience gained during the COVID-19 pandemic, particularly in patients with acute respiratory distress syndrome (ARDS) and reduced lung compliance, has provided reassuring evidence. [2, 34, 35] Several teams have reported the possibility of using infusion volumes of 2 to 2.5 L without impairing respiratory function or desynchronizing ventilation. Nevertheless, it is recommended to stop exchanges during prone positioning phases to avoid an increase in PIP that could interfere with mechanical ventilation. The feasibility of PD in the prone position remains poorly documented, with some isolated reports mentioning technical constraints, such as compression of the tubing, intra-abdominal hyperpressure, or diaphragmatic restriction, [36] requiring consideration of a more lateral catheter exit site than in normal situations.

Although studies in healthy subjects confirm a theoretical reduction in residual functional capacity after a 2 L dialysate infusion, no worsening of hypoxemia (PaO2/F_iO2 ratio) or increase in the need for intubation after initiation of PD has been reported, including in patients on spontaneous-assisted ventilation. In the reported series, PD effectively corrected fluid and electrolyte imbalances with daily volumes of 15 to 25 L (8 to 20 exchanges per day) and weekly Kt/V values >2.2, sometimes in combination with HD or continuous hemofiltration during periods of prolonged prone positioning. [34, 36]

In summary, when instillation volumes and patient positioning are appropriate, PD does not appear to compromise respiratory mechanics and remains a safe modality in mechanically ventilated patients, provided intra-abdominal pressure and respiratory status are carefully monitored.

- *Slower elimination of toxins or toxic substances*

The slower clearance kinetics compared to HD for reducing life-threatening hyperkalemia or drug intoxication are at the top of the list of limitations of PD in critical situations. PD remains generally less effective (can reach 25% of HD clearance) than HD or continuous hemodiafiltration techniques for eliminating many toxic substances in cases of acute drug poisoning. [28] In the absence of an alternative or in cases of moderate poisoning, it can be used with partial effectiveness compared to HD in acute poisoning by substances <500 Da that are highly water-soluble and have low protein binding (<80%). Since the elimination of toxins in PD is mainly diffusive, it will therefore depend on the flow rate of the successively infused volumes (number of cycles and stasis time), the molecular weight and serum concentration of the toxic molecule, and its binding to proteins. For example, certain toxins—such as lithium, acyclovir, phenobarbital, ethylene glycol, and methanol—can still be effectively eliminated by high-volume PD within 48–72 hours. [42] Due to the faster clearance rate in HD, PD should not be offered in life-threatening situations or unless other renal replacement methods are unavailable. [40]

- *Less predictable ultrafiltration*

UF in PD remains less predictable and slower than in HD, although more than 2 L per day can

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be removed using hypertonic solutions and/or successive short cycles. [3] In cycles of less than 120 minutes, the removal of free water may predominate over the removal of salt-coupled water, and care should be taken to avoid the risk of hypernatremia. [41] Hydraulic catheter dysfunction may also occur as a result of constipation or even ileus, which is very common in patients who are bedridden for long periods, leading to additional mechanical ultrafiltration failure. Critical patients should therefore be treated with laxatives as a preventive measure, and drainage should be performed in the supine position rather than the prone position.

- Mechanical complications

Among the mechanical complications associated with USPD, intra- or extraluminal catheter obstructions are common. They can be caused by the formation of intraluminal fibrin clots, which is promoted by the procoagulant state of patients in intensive care or major fecal stasis. Careful monitoring of the catheter is essential, along with corrective measures such as rigorous aseptic flushing and the systematic addition of heparin (500 to 1,000 U/L) in the first exchanges and mild laxatives to prevent obstruction. [42]

Catheter migration (often in the upper position) or mechanical twisting can also cause hydraulic dysfunction. An abdominal X-ray can usually identify these abnormalities, and targeted repositioning using interventional radiology or laparoscopy, depending on the type of anesthesia used, may be necessary. [5]

Early leaks (along the subcutaneous path or around the insertion area of the inner sleeve) are another common complication, especially if too large volumes are instilled immediately after catheter placement. This situation can be avoided by limiting exchange volumes to less than 1–1.5L L during the first 72 hours of treatment, maintaining strict supine position during exchanges and periods of empty abdomen (8 hours/24 hours min) to promote healing. [3]

Experience gained during the COVID-19 pandemic has demonstrated the feasibility of PD in UDR. Catheter insertion was successful in 85–95% of cases in selected patients, although those with abdominal obesity, a history of complex subumbilical surgery, or severe thrombocytopenia/coagulopathy were excluded. [2,43,44] The rate of major complications, including gastrointestinal perforations and dialysate leaks, remained low (<2–5%). This apparent safety can be partly explained by a center effect (technical expertise of teams in applying emergency PD protocols), a bias inherent in this type of observational report.

- Infectious complications

While PD spares patients from the risk of central catheter-related bacteremia, peritonitis (infection of the dialysate fluid), whether hand-carried or enteric in origin, remains a feared complication in critically ill patients. As the usual signs of abdominal pain are masked, it is necessary to regularly monitor the nucleated elements (NE) in the dialysate, [3] especially in the context of prolonged antibiotic therapy, so as not to miss a secondary fungal peritonitis. In addition, antibiotic prophylaxis with vancomycin or first-generation cephalosporin, depending on the center's microbiology, [3] is recommended during PD catheter placement to prevent early infections of the exit site or tunnel after placement (percutaneous or laparoscopic).

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All of these mechanical or infectious complications specific to PD warrant close multidisciplinary management involving nephrologists, intensive care specialists, and dedicated nursing staff. [7, 27, 29, 33, 45]

Furthermore, in the context of acute peritoneal dialysis in intensive care, the pharmacokinetics of intraperitoneally administered antibiotics differ from those observed in chronic settings. Recent data show that the elimination of certain molecules, particularly cephalosporins and vancomycin, is clinically significant in acute PD, with significant variability in serum and intraperitoneal concentrations. In particular, therapeutic vancomycin concentrations are not always achieved and are associated with clinical success, suggesting that plasma concentration monitoring is warranted to adjust dosages and optimize infection cure in critically ill patients. [46]

Obstacles, organizational contributions, and lessons from the COVID-19 crisis

The underuse of PD in many hospitals can be explained by a series of institutional, organizational, and cultural factors. In several low-resource countries, PD plays a predominant role, while in industrialized countries, CRRT and HD remain the norm. [5] There are many reasons for this, including a tradition of HD-focused training, the perceived adequacy of HD/CVV(HD)F monitors, and a lack of practical training for staff in PD. A number of young nephrologists report that they do not feel sufficiently prepared to prescribe and manage PD. [47] No similar survey has been conducted among intensive care physicians and nurses to date. However, the implementation of this modality in intensive care may also be hampered by negative perceptions of the effectiveness or safety of PD and its impact on ventilation (mechanical respiration), as well as by the need for interdisciplinary coordination (nephrologists, surgeons, intensive care nurses familiar with the technique), which is complicated by the rapid turnover of staff in the UDR.

However, the COVID-19 pandemic has shown that PD can be deployed effectively in ICUs, even under extreme conditions of logistical shortages. Faced with an incidence of AKI reaching 5 to 25% in patients in intensive care for SARS-CoV-2 pneumonia, several international centers (USA, United Kingdom, China, Australia) have urgently implemented PD programs in ICUs. [2, 44, 45]

Despite the initial lack of material and human resources, catheter insertion proved to be largely successful (85–95%), with a low rate of major complications (<5%), in line with the observations already reported in the previous sections. This success is due to previously experienced PD teams who were able to quickly implement care protocol for PD in UDRs concerning patient selection (exclusion of abdominal obesity, recent abdominal surgery, coagulopathies), the volumes infused in the initial phase (1–1.5 L) and their adjustment in the steady state phase to cover hypercatabolism (up to 12–25 L/day), and specific clinical monitoring of the catheter, dialysate, and exit site, procedures that enabled accelerated and supervised training of staff in these expert centers. [35]

These experiences therefore confirm that, in a crisis context, PD is a safe and effective treatment option for severe AKI, subject to agile interdisciplinary organization, structured nephrological supervision, and rigorous technical support. (*Figure 1*)

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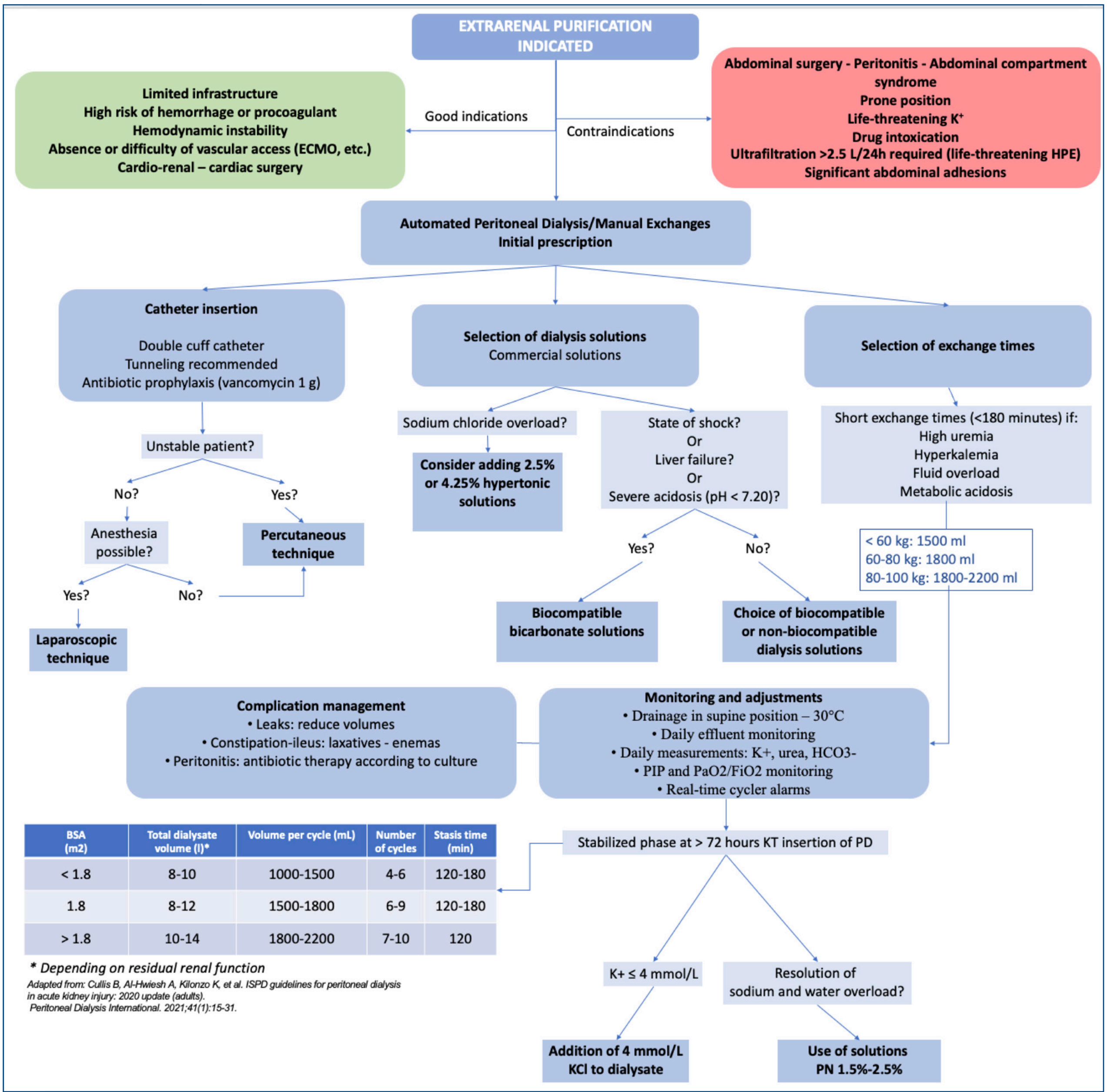

BSA (m2)	Total dialysate volume (l)*	Volume per cycle (mL)	Number of cycles	Stasis time (min)
< 1.8	8-10	1000-1500	4-6	120-180
1.8	8-12	1500-1800	6-9	120-180
> 1.8	10-14	1800-2200	7-10	120

Figure 1. Decision algorithm for the implementation and prescription of peritoneal dialysis in intensive care.
ECMO: extracorporeal membrane oxygenation; HPE: hemodynamic pulmonary edema; BSA: body surface area

Future prospects

The development of PD in intensive care would benefit from support from more numerous, larger-scale prospective clinical studies to confirm the non-inferiority of this technique across a variety of critical care settings (and not only in situations of shortage). Future research should evaluate the impact of PDo on enal function recovery, mortality and quality of life after intensive care, satisfaction and workload for the intensive care team, and finally, the economic impact of such an approach on social security. On a practical level, training and exposing caregivers to this alternative technique remains a crucial challenge in changing organizational culture and demystifying false beliefs among medical teams. PD should be systematically included in nephrology and resuscitation curricula to raise awareness of this modality among resuscitation physicians. Technological developments, particularly in the field of telemonitoring and artificial intelligence, suggest that PD with controlled assistance could be further customized, which could facilitate its adoption by more teams.

Conclusion

Long relegated to the background in intensive care units in high-income countries, PD is attracting renewed interest, reinforced by its life-saving role during the COVID-19 pandemic. While its effectiveness in crisis situations has been demonstrated, its advantages—hemodynamic stability, preservation of residual renal function, no need for vascular access or anticoagulation, and low dependence on infrastructure—support its permanent reintegration into the management of AKI, including in critical situations.

Available studies confirm clinical results comparable to those of HD or CVVH(D), provided that protocols are adapted and teams are trained. The current underuse of PD is due more to cultural and organizational barriers and a lack of training (and therefore interest) than to real technical or medical limitations.

Reconsidering PD as a treatment option in its own right—rather than a fallback—requires better integration into training programs, structured protocols, and close collaboration among nephrologists, intensive care specialists, surgeons, and nurses. It is an effective, adaptable, and safe option that deserves to regain its rightful place in the arsenal of modern intensive care units.

Authors' Contributions

L.J. wrote the first draft of the manuscript. A.-L.C. supervised the development and writing of the text. M.T., J.L., A.L., M.T.S., K.F., M.C., and G.G. participated in the critical revision of the manuscript and made substantial intellectual contributions to its improvement. All authors read and approved the final version.

Ethical Considerations

NA

Patient Consent

NA

Data availability

NA

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Conflicts of Interest

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