COMPOSITION OF REPLACEMENT FLUID AND DIALYSATE FOR CRRT

Replacement Fluid

Investigator	Golper [19]	Kierdorf [20]	Lauer [21]	Paganini [22]	Mehta [11]	Mehta [11]
Na^+	147	140	140	140	140.5	154
Cl^-	115	110	—	120	115.5	154
HCO_3^-	36	34	—	6	25	—
K^+	0	0	2	2	0	—
Ca^{2+}	1.2	1.75	3.5	4	4	—
Mg^{2+}	0.7	0.5	1.5	2	—	—
Glucose	6.7	5.6	—	10	—	—
Acetate	—	—	41	40	—	—

Dialysate

Component (mEq/L)	1.5% Dianeal	Hemosol AG 4D	Hemosol LG 4D	Baxter	Citrate
Sodium	132	140	140	140	117
Potassium	—	4	4	2	4
Chloride	96	119	109.5	117	121
Lactate	35	—	40	30	—
Acetate	—	30	—	—	—
Calcium	3.5	3.5	4	3.5	—
Magnesium	1.5	1.5	1.5	1.5	1.5
Dextrose (g/dL)	1.5	0.8	.11	0.1	0.1–2.5

FIGURE 19-15

Composition of dialysate and replacement fluids used for continuous renal replacement therapy (CRRT). One of the key features of any dialysis method is the manipulation of metabolic balance. In general, this is achieved by altering composition of dialysate or replacement fluid . Most commercially available dialysate and replacement solutions have lactate as the base; however, bicarbonate-based solutions are being utilized more and more [17,18].

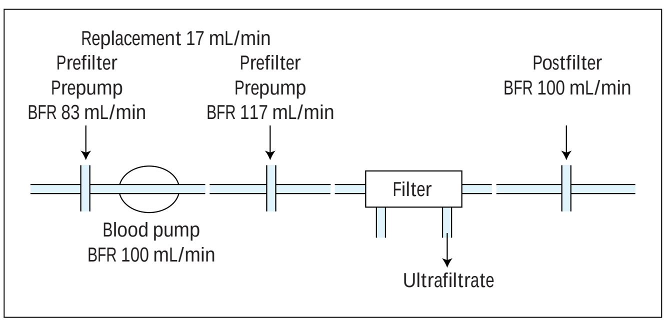

FIGURE 19-16

Effect of site of delivery of replacement fluid: pre- versus postfilter continuous venovenous hemofiltration with ultrafiltration rate of 1 L/hour. Replacement fluids may be administered pre- or postfilter, depending on the circuit involved . It is important to recognize that the site of delivery can influence the overall efficacy of the procedure. There is a significant effect of fluid delivered prepump or postpump, as the amount of blood delivered to the filter is reduced in prepump dilution. BFR—blood flow rate.

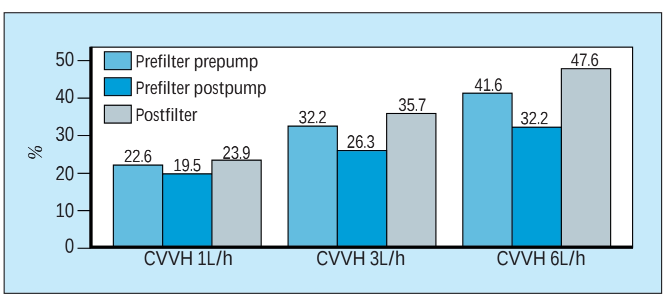

FIGURE 19-17

Pre- versus postfilter replacement fluid: effect on filtration fraction. Prefilter replacement tends to dilute the blood entering the circuit and enhances filter longevity by reducing the filtration fraction; however, in continuous venovenous hemofiltration (CVVH) circuits the overall clearance may be reduced as the amount of solute delivered to the filter is reduced.

Applications and Indications for Dialytic Intervention

INDICATIONS AND TIMING OF DIALYSIS FOR ACUTE RENAL FAILURE: RENAL REPLACEMENT VERSUS RENAL SUPPORT

	Renal Replacement	Renal Support
Purpose	Replace renal function	Support other organs
Timing of intervention	Based on level of biochemical markers	Based on individualized need
Indications for dialysis	Narrow	Broad
Dialysis dose	Extrapolated from ESRD	Targeted for overall support

FIGURE 19-18

Dialysis intervention in acute renal failure (ARF): renal replacement versus renal support. An important consideration in the management of ARF is defining the goals of therapy. Several issues must be considered, including the timing of the intervention, the amount and frequency of dialysis, and the duration of therapy. In practice, these issues are based on individual preferences and experience, and no immutable criteria are followed [7,23]. Dialysis intervention in ARF is usually considered when there is clinical evidence of uremia symptoms or biochemical evidence of solute and fluid imbalance. An important consideration in this regard is to recognize that the patient with ARF is somewhat different than the one with end-stage renal disease (ESRD). The rapid decline of renal function associated with multiorgan failure does not permit much of an adaptive response which characterizes the course of the patient with ESRD. As a consequence, the traditional indications for renal replacement may need to be redefined. For instance, excessive volume resuscitation, a common strategy for multiorgan failure, may be an indication for dialysis, even in the absence of significant elevations in blood urea nitrogen. In this respect, it may be more appropriate to consider dialysis intervention in the intensive care patient as a form of renal support rather than renal replacement. This terminology serves to distinguish between the strategy for replacing individual organ function and one to provide support for all organs.

POTENTIAL APPLICATIONS FOR CONTINUOUS RENAL REPLACEMENT THERAPY

Renal Replacement	Renal Support	Extrarenal Applications
Acute renal failure	Fluid management	Cytokine removal ? sepsis
Chronic renal failure	Solute control	Heart failure
	Acid-base adjustments	Cancer chemotherapy
	Nutrition	Liver support
	Burn management	Inherited metabolic disorders

FIGURE 19-19

Potential applications for continuous renal replacement therapy (CRRT). CRRT techniques are increasingly being utilized as support modalities in the intensive care setting and are particularly suited for this function. The freedom to provide continuous fluid management permits the application of unlimited nutrition, adjustments in hemodynamic parameters, and achievement of steady-state solute control, which is difficult with intermittent therapies. It is thus possible to widen the indications for renal intervention and provide a customized approach for the management of each patient.

RELATIVE ADVANTAGES (+) AND DISADVANTAGES (−) OF CRRT, IHD, AND PD

Variable	CRRT	IHD	PD
Continuous renal replacement	+	−	+
Hemodynamic stability	+	−	+
Fluid balance achievement	+	−	−
Unlimited nutrition	+	−	−
Superior metabolic control	+	−	−
Continuous removal of toxins	+	−	+
Simple to perform	±	−	+
Stable intracranial pressure	+	−	+
Rapid removal of poisons	−	+	−
Limited anticoagulation	−	+	+
Need for intensive care nursing support	+	−	+
Need for hemodialysis nursing support	±	+	+
Patient mobility	−	+	−

FIGURE 19-20

Advantages (+) and disadvantages (−) of dialysis techniques. CRRT—continuous renal replacement therapy; IHD—intermittent hemodialysis; PD—peritoneal dialysis.

DETERMINANTS OF THE CHOICE OF TREATMENT MODALITY FOR ACUTE RENAL FAILURE

- Patient
  - Indication for dialysis
  - Presence of multiorgan failure
  - Access
  - Mobility and location of patient
  - Anticipated duration of therapy
- Dialysis process
  - Components (*eg*, membrane, anticoagulation)
  - Type (intermittent or continuous)
  - Efficacy for solute and fluid balance
  - Complications
  - Outcome
- Nursing and other support
  - Availability of machines
  - Nursing support

FIGURE 19-21

Determinants of the choice of treatment modality for acute renal failure. The primary indication for dialysis intervention can be a major determinant of the therapy chosen because different therapies vary in their efficacy for solute and fluid removal. Each technique has its advantages and limitations, and the choice depends on several factors. Patient selection for each technique ideally should be based on a careful consideration of multiple factors [1]. The general principle is to provide adequate renal support without adversely affecting the patient. The presence of multiple organ failure may limit the choice of therapies; for example, patients who have had abdominal surgery may not be suitable for peritoneal dialysis because it increases the risk of wound dehiscence and infection. Patients who are hemodynamically unstable may not tolerate intermittent hemodialysis (IHD). Additionally, the impact of the chosen therapy on compromised organ systems is an important consideration. Rapid removal of solutes and fluid, as in IHD, can result in a disequilibrium syndrome and worsen neurologic status. Peritoneal dialysis may be attractive in acute renal failure that complicates acute pancreatitis, but it would contribute to additional protein losses in the hypoalbuminemic patient with liver failure.