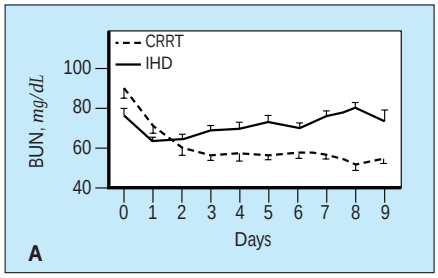
RECOMMENDATION FOR INITIAL DIALYSIS MODALITY FOR ACUTE RENAL FAILURE (ARF)

Indication	Clinical Condition	Preferred Therapy
Uncomplicated ARF	Antibiotic nephrotoxicity	IHD, PD
Fluid removal	Cardiogenic shock, CP bypass	SCUF, CAVH
Uremia	Complicated ARF in ICU	CVVHDF, CAVHDF, IHD
Increased intracranial pressure	Subarachnoid hemorrhage, hepatorenal syndrome	CVVHD, CAVHD
Shock	Sepsis, ARDS	CVVH, CVVHDF, CAVHDF
Nutrition	Burns	CVVHDF, CAVHDF, CVVH
Poisons	Theophylline, barbiturates	Hemoperfusion, IHD, CVVHDF
Electrolyte abnormalities	Marked hyperkalemia	IHD, CVVHDF
ARF in pregnancy	Uremia in 2nd, 3rd trimester	PD

FIGURE 19-22

Recommendation for initial dialysis modality for acute renal failure (ARF). Patients with multiple organ failure (MOF) and ARF can be treated with various continuous therapies or IHD. Continuous therapies provide better hemodynamic stability; however, if not monitored carefully they can lead to significant volume depletion. In general, hemodynamically unstable, catabolic, and fluid-overloaded patients are best treated with continuous therapies, whereas IHD is better suited for patients who require early mobilization and are more stable. It is likely that the mix of modalities used will change as evidence linking the choice of modality to outcome becomes available. For now, it is probably appropriate to consider all these techniques as viable options that can be used collectively. Ideally, each patient should have an individualized approach for management of ARF.

Outcomes



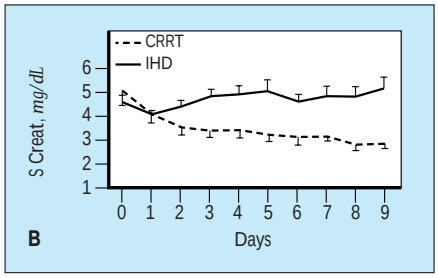


FIGURE 19-23

Efficacy of continuous renal replacement therapy (CRRT) versus intermittent hemodialysis (IHD): effect on blood urea nitrogen, **A**, and creatinine levels, **B**, in acute renal failure.

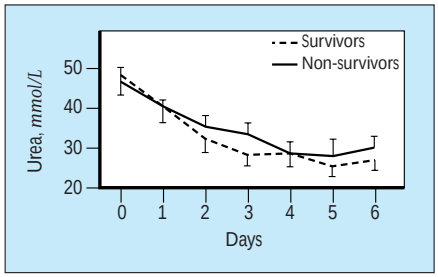


FIGURE 19-24

Blood urea nitrogen (BUN) levels in survivors and non-survivors in acute renal failure treated with continuous renal replacement therapy (CRRT). It is apparent that CRRT techniques offer improved solute control and fluid management with hemodynamic stability, however a relationship to outcome has not been demonstrated. In a recent retrospective analysis van Bommel [24] found no difference in BUN levels among survivors and non-survivors with ARF While it is clear that lower solute concentrations can be achieved with CRRT whether this is an important criteria impacting on various outcomes from ARF still needs to be determined. A recent study form the Cleveland Clinic suggests that the dose of dialysis may be an important determinant of outcome allowing for underlying severity of illness [25]. In this study the authors found that in patients with ARF, 65.4% of all IHD treatments resulted in lower Kt/V than prescribed. There appeared to be an influence of dose of dialysis on outcome in patients with intermediate levels of severity of illness as judged by the Cleveland Clinic Foundation acuity score for ARF (*see* Fig. 19-25). Patients receiving a higher Kt/V had a lower mortality than predicted. These data illustrate the importance of the underlying severity of illness, which is likely to be a major determinant of outcome and should be considered in the analysis of any studies.

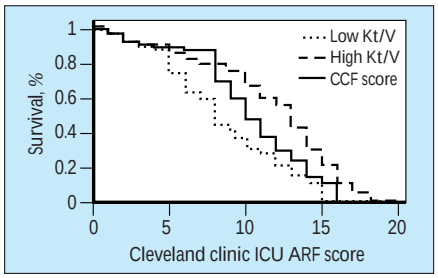


FIGURE 19-25

Effect of dose of dialysis in acute renal failure (ARF) on outcome from ARF.

BIOCOMPATIBLE MEMBRANES IN INTERMITTENT HEMODIALYSIS (IHD) AND ACUTE RENAL FAILURE (ARF): EFFECT ON OUTCOMES

	BCM Group	BICM Group	Probability
Patients, *n*	72	81	
All patients recover of renal function	46 (64%)	35 (43%)	0.001
Survival	41 (57%)	37 (46%)	0.03
Patients nonoliguric before hemodialysis	39	46	
Development of oliguria with dialysis	17 (44%)	32 (70%)	0.03
Recovery of renal function	31 (79%)	21 (46%)	0.0004
Survival	28 (74%)	22 (48%)	0.003
Patients oliguric before hemodialysis	33	35	
Recovery of renal function	15 (45%)	14 (40%)	ns
Survival	12 (36%)	15 (43%)	ns

FIGURE 19-26

Biocompatible membranes in intermittent hemodialysis (IHD) and acute renal failure (ARF): effect on outcomes. The choice of dialysis membrane and its influence on survival from ARF has been of major interest to investigators over the last few years. While the evidence tends to support a survival advantage for biocompatible membranes, most of the studies were not well controlled. The most recent multicenter study showed an improvement in mortality and recovery of renal function with biocompatible membranes; however, this effect was not significant in oliguric patients. Further investigations are required in this area. NS—not significant.

MORTALITY IN ACUTE RENAL FAILURE: COMPARISON OF CRRT VERSUS IHD

		IHD		CRRT			
Investigator	Type of Study	No	Mortality, %	No	Mortality, %	Change, %	P Value
Mauritz [32]	Retrospective	31	90	27	70	−20	ns
Alarabi [33]	Retrospective	40	55	40	45	−10	ns
Mehta [34]	Retrospective	24	85	18	72	−13	ns
Kierdorf [20]	Retrospective	73	93	73	77	−16	< 0.05
Bellomo [35]	Retrospective	167	70	84	59	−11	ns
Bellomo [36]	Retrospective	84	70	76	45	−25	< 0.01
Kruczynski [37]	Retrospective	23	82	12	33	−49	< 0.01
Simpson [38]	Prospective	58	82	65	70	−12	ns
Kierdorf [39]	Prospective	47	65	48	60	−4.5	ns
Mehta [40]	Prospective	82	41.5	84	59.5	+18	ns

FIGURE 19-27

Continuous renal replacement therapy (CRRT) versus intermittent hemodialysis (IHD): effect on mortality. Despite significant advances in the management of acute renal failure (ARF) over the last four decades, the perception is that the associated mortality has not changed significantly [26]. Recent publications suggest that there may have been some improvement during the last decade [27]. Both IHD and peritoneal dialysis (PD) were the major therapies until a decade ago, and they improved the outcome from the 100% mortality of ARF to its current level. The effect of continuous renal replacement therapy on overall patient outcome is still unclear [28] . The major studies done in this area do not show a survival advantage for CRRT [29,30]. Although several investigators have not been able to demonstrate an advantage of these therapies in influencing mortality, we believe this may represent the difficulty in changing a global outcome which is impacted by several other factors [31]. It is probably more relevant to focus on other outcomes such as renal functional recovery rather than mortality. We believe that continued research is required in this area; however, there appears to be enough evidence to support the use of CRRT techniques as an alternative that may be preferable to IHD in treating ARF in an intensive care setting.

Future Directions

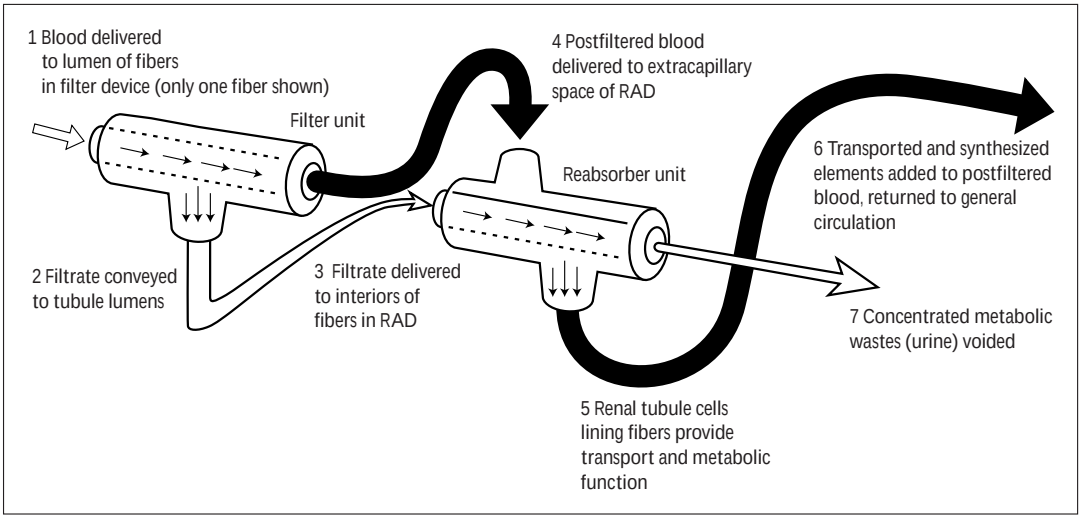


FIGURE 19-28

Schematic for the bioartificial kidney. As experience with these techniques grows, innovations in technology will likely keep pace. Over the last 3 years, most of the major manufacturers of dialysis equipment have developed new pumps dedicated for continuous renal replacement therapy (CRRT). Membrane technology is also evolving, and antithrombogenic membranes are on the horizon [41]. Finally the application of these therapies is likely to expand to other arenas, including the treatment of sepsis, congestive heart failure [42], and multiorgan failure [43]. An exciting area of innovative research is the development of a bioartificial tubule utilizing porcine tubular epithelial cells grown in a hollow fiber to add tubular function to the filtrative function provided by dialysis [44]. These devices are likely to be utilized in combination with CRRT to truly provide complete RRT in the near future. (*From* Humes HD [44]; with permission.)

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