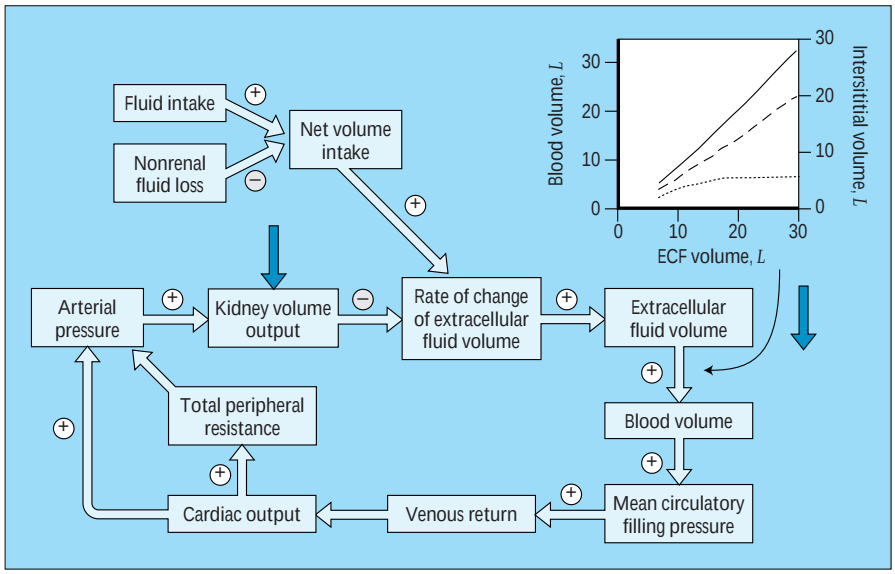

FIGURE 2-39

Mechanisms of extracellular fluid (ECF) volume expansion in nephrotic syndrome. Nephrotic syndrome is characterized by hypoalbuminemia, which shifts the relation between blood and interstitial volume upward (dashed to solid lines in inset). As discussed in Figure 2-35, these effects of hypoalbuminemia are evident when serum albumin concentrations decrease by more than half. In addition, however, hypoalbuminemia may induce vasodilation and arterial hypotension that lead to sodium (Na) retention, independent of transudation of fluid into the interstitium [73,74]. Unlike other states of hypoproteinemia and vasodilation, however, nephrotic syndrome usually is associated with normotension or hypertension. Coupled with the observation made in Figure 2-36 that natriuresis may take place before increases in serum albumin concentration in patients with nephrotic syndrome, these data implicate an important role for primary renal Na retention in this disorder (dark blue arrow). As suggested by Figure 2-37, the decrease in urinary Na excretion may play a larger role in patients with acute glomerulonephritis than in patients with minimal change nephropathy [71].

Extracellular Fluid Volume Homeostasis in Chronic Renal Failure

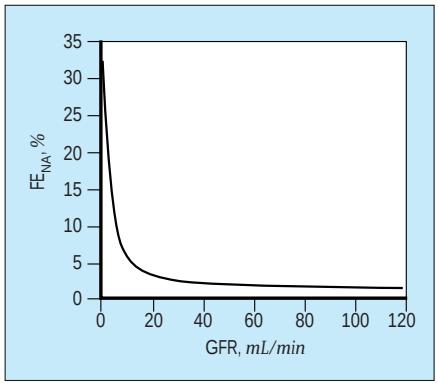

FIGURE 2-40

Relation between glomerular filtration rate (GFR) and fractional sodium (Na) excretion (FE_{Na}). The normal FE_{Na} is less than 1%. Adaptations in chronic renal failure maintain urinary Na excretion equal to dietary intake until end-stage renal disease is reached. To achieve this, the FE_{Na} must increase as the GFR decreases.

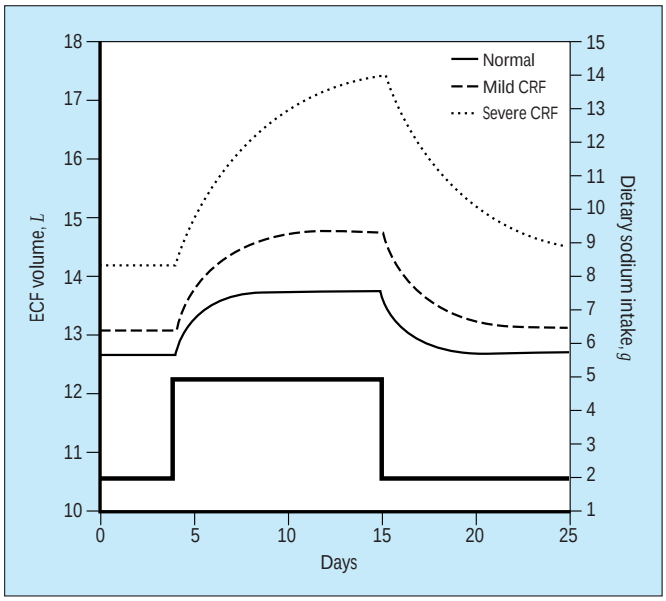

FIGURE 2-41

Effects of dietary sodium (Na) intake on extracellular fluid (ECF) volume in chronic renal failure (CRF) [75]. Compared with normal persons, patients with CRF have expanded ECF volume at normal Na intake. Furthermore, the time necessary to return to neutral balance on shifting from one to another level of Na intake is increased. Thus, whereas urinary Na excretion equals dietary intake of Na within 3 to 5 days in normal persons, this process may take up to 2 weeks in patients with CRF. This time delay means that not only are these patients susceptible to volume overload, but also to volume depletion. This phenomenon can be modeled simply by reducing the time constant (k) given in the equation in Figure 2-2, and leaving the set point (A_0) unchanged. The curves here represent time constants of 0.79 ±0.05 day_{-1} (normal), 0.5 day_{-1} (mild CRF), and 0.25 day_{-1} (severe CRF).

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