Lactate Dialysate Requirements In Short Daily Hemodialysis Therapies

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Introduction

The benefits of self-care and/or daily hemodialysis therapy are well described in the literature. These alternatives may be more practical to administer outside of traditional center settings, where hemodialysis therapies have seen limited penetration over the last 25 years.

Conversely, peritoneal dialysis has been the "therapy of choice" in these settings. A primary difference between hemodialysis and peritoneal dialysis is in the source of therapy fluids. A therapy using prepackaged, lactate-based solutions (as in peritoneal dialysis) avoids logistical challenges associated with water processing and on-line production of bicarbonate dialysate, and may simplify therapy administration.

Although prepackaged lactate dialysate solutions have seen regular use in critical care, little has been published on their use in chronic hemodialysis. Dalal et al. (KI 1990) demonstrated that a lactate level of 46 mEq/L effectively controls acid/base status in 3 times per week hemodialysis therapy. Kinetic modeling based on observed in vitro dialysance values (Friederichs et al, F-P0378 ASN 2004) predicts that in a 6-times per week therapy with low dialysate flow rates (~1/4 of blood flow rate) delivering a std Kt/V of 2.1, a dialysate concentration of 42 mEq/L would result in a mid-week bicarbonate concentration of 22 mEq/L in a 70 kg patient with an acid production of 60 mEq/day.

Objectives

1. Compare kinetic modeling predictions to empirical results for 8 patients receiving 6-times/week therapy.
2. Determine the extent of serum lactate level elevation during and subsequent to treatment.
3. Propose factors that may be considered when determining the appropriate dialysate lactate levels for individual patients

Methods

8 patients were involved in this study. All were stable in-center conventional hemodialysis patients prior to initiating 6 times/weekly therapy with lactate-based dialysate. Data was collected mid-week 4 and 8 weeks after the initiation of the therapy to allow for patient stabilization. Table 1 outlines patient and therapy characteristics.

Table 1: Patient Characteristics

Number of Patients	8 (6 male, 2 female)		
Patient weight (kg) Mean±SD (Range)	88.7±16.4 (65 – 112.5)		
	Baseline (IHD)	**4 Weeks (DHD)**	**8 Weeks (DHD)**
Mean time per session (min)	204	176	173
Mean net ultrafiltration per session (L)	2.1	1.6	1.7
Delivered weekly standard Kt/V	2.3	2.2	2.1

Lactate levels were checked in the first 4 patients pre-, post-, and 1 hour post-treatment after 4 weeks.

Two dialysate formulations were used for this study, differing primarily in their concentration of lactate buffer (Table 2). All patients began with 40 mEq/L dialysate; 3 changed after 4 weeks to 45 mEq/L because of low pre-treatment bicarbonate levels.

Table 2: Dialysate Composition

		Concentration	
Constituent	**Measure**	**Solution A**	**Solution B**
Sodium (Na^+)	mEq/L	140	140
Calcium (Ca^{2+})	mEq/L	3	3
Potassium (K^+)	mEq/L	1	1
Magnesium (Mg^{2+})	mEq/L	1	1
Lactate ($C_3H_5O_3$)	mEq/L	40	45
Chloride (Cl^-)	mEq/L	109	104
Glucose	mg/dL	100	100

Results

Predicted vs. actual pre-treatment bicarbonate values at 4 and 8 weeks are shown in Figure 1. Acid/base control was as predicted, and similar to that of conventional thrice-weekly bicarbonate dialysis.

Figure 1: Predicted vs. Actual Pre-Tx Bicarbonate Values

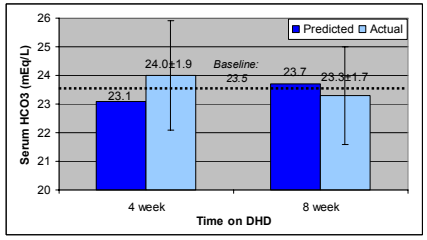
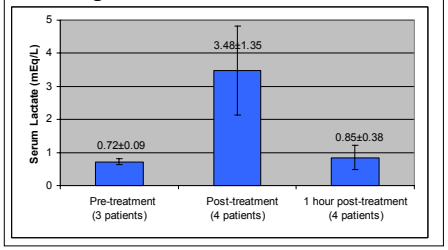


Figure 2 describes lactate level elevation during and post treatment in patients on daily hemodialysis therapy with lactate dialysis.

Figure 2: Observed Serum Lactate Values



Lactate levels become slightly elevated by the end of the therapy, and return to baseline levels within one hour of conclusion of therapy. The observed elevated post-treatment lactate levels are well below than those typically seen following moderate exercise (Lindinger et al, Am. J. Physiology 1992).

Patients requiring the higher lactate dialysate were noted to have lower pretreatment bicarbonate levels on conventional 3/week dialysis, and on daily dialysis to have a lower net ultrafiltration/session and shorter treatment time (Table 3). This is consistent with the findings from kinetic modeling.

Table 3: Dialysate Selection

	40 Lactate	**45 Lactate**
Patient weight (kg)	90±13	86±24
Number of female patients	1	1
Number of male patients	4	2
Patient net ultrafiltration/session (kg)	1.3±0.5	1.9±0.8
Treatment time (min)	186±19	145±34
Baseline plasma bicarbonate – conventional HD (mEq/L)	24.1±1.4	21.3±4.2

Conclusion

In summary, in this patient sample lactate-based dialysate at 40 or 45 mEq/L is shown to control acid/base status without sustained elevation of pre- or post-treatment lactate levels. These results are consistent with kinetic modeling predictions. Additional clinical experience may aid in proactive selection of the optimal patient lactate buffer concentration in the dialysate.