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Thoughts and Progress

It is the goal of this section to publish material that provides information regarding specific issues, aspects of artificial organ application, approach, philosophy, suggestions, and/or thoughts for the future.

Preparation of Ethanol-Enriched, Bicarbonate-Based Hemodialysates

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Abstract: We describe a method to produce bicarbonate-based dialysates containing ~100 mg/dl ethanol by introducing the alcohol into one of the dialysate concentrate solutions geared for the production of bicarbonate-based dialysates. **Key Words:** Ethanol—Bicarbonate—Dialysate—Dialysate concentrate.

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Ethanol is used in the treatment of poisonings by methanol or ethylene glycol (1–4). In the event that a patient needs dialysis, ethanol, in addition to being given via the oral or intravenous route, can conveniently be introduced into the dialysate so that a more stable blood ethanol level can be attained (3,4).

Currently, two basic, dual concentrate, bicarbonate-based, proportioning dialysate generating systems are in common use by dialysis units in the U.S.A. Championed by Sargent et al. (5), one of the systems utilizes a base dialysate concentrate solution containing sodium, chloride, and bicarbonate as well as an acid dialysate concentrate solution (Renasol concentrates, Renal Systems, Minneapolis, MN, U.S.A.) containing sodium, potassium, calcium, magnesium, chloride, acetic acid, and glucose. The other system was pioneered by Delin et al. (6) and is characterized by having a sodium bicarbonate powder housed in a cartridge as well as an acid dialysate concentrate solution harboring glucose, acetic acid, and the rest of the constituent electrolytes. In addition, a modification of the Delin system utilizing a sodium bicarbonate dialysate concentrate solution instead of a sodium bicarbonate powder as the source of bicarbonate is also commercially available

TABLE 1. *Volume of ethanol-free dialysate concentrate solution and that of absolute alcohol required for the creation of 1 L of an ethanol-enriched dialysate concentrate*

Ethanol-free dialysate concentrate to be enriched with ethanol	Degree of dilution[a]	Volume of dialysate concentrate[b] (ml)	Volume of absolute alcohol[c] (ml)
Sargent method			
Acid concentrate	×36.83	953.4	46.6 (36.8)
Base concentrate	×20.13	974.5	25.5 (20.1)
Modified Delin method			
Acid concentrate	×45.00	944.3	56.3 (45)
Base concentrate	×26.14	966.9	33.1 (26)

[a] Required for ethanol-enriched dialysate concentrate to become a final dialysate.
[b] Required for the creation of 1 L of ethanol-enriched dialysate concentrate. Geared for the generation of a dialysate containing approximately 100 mg/dl ethanol.
[c] Required for creation of 1 L of ethanol-enriched dialysate concentrate. Geared for the generation of a dialysate containing approximately 100 mg/dl ethanol. Figures within parentheses represent grams, the specific gravity of absolute alcohol being 0.794.

TABLE 2. *Ethanol, sodium, and chloride levels in ethanol-enriched hemodialysates*

Ethanol-enriched dialysate concentrate[a]	Dialysate ethanol level (mg/dl)	Dialysate sodium level (m*M*)	Dialysate chloride level (m*M*)
Sargent method			
Acid concentrate	106	143	110
Base concentrate	110	142	110
Modified Delin method			
Acid concentrate	110	143	113
Base concentrate	112	143	114

[a] Each of the ethanol-enriched dialysate concentrates listed was routed through a dual concentrate, bicarbonate-based, dialysate generating machine in a manner similar to the one utilized in a regular dialysis (including, of course, the simultaneous routing of the respective conjugate ethanol-free member of the dual concentrate pair) to produce the desired ethanol-enriched, bicarbonate-based dialysate.

(Renalyte Rx sodium bicarbonate concentrate, Gambro Healthcare, Lakewood, CO, U.S.A.). To our knowledge there are no detailed studies describing the feasibility of adding ethanol to dialysate concentrates nor of the accuracy of ethanol delivery when these dialysate concentrates are used in conjunction with proportioning dialysate generating machines.

Materials and methods

In an attempt to determine the feasibility of enriching the previously described dialysate concentrate solutions with ethanol, we introduced absolute alcohol (100% ethanol, i.e., 200 proof) to each of these solutions in the following manner. An amount of ethanol sufficient to produce (when using a dual concentrate, bicarbonate-based, proportioning dialysate generating machine) a final dialysate possessing approximately 100 mg/dl ethanol was used. Table 1 describes the quantity of absolute alcohol that had to be added to one of the dialysate concentrates to constitute a liter of an ethanol containing concentrate geared for the production of a bicarbonate-based dialysate having approximately 100 mg/dl ethanol.

Results

The results are depicted in Table 2. The planned target ethanol level in the realm of 100 mg/dl was achieved in all instances.

Discussion

The use of dialysates enriched with ethanol to dialyze patients suffering from ethylene glycol poisoning was first suggested by Peterson et al. (1). However, previous attempts to enrich dialysates with ethanol have primarily involved the use of batch system dialysates employing acetate-based concentrates (2). To prepare ethanol-enriched, bicarbonate-based dialysates using proportioning, single pass machines, we previously introduced the alcohol into the dialysate inlet of a dialyzer with the use of an infusion pump and a T tube inserted into the dialysate delivery tubing (3). To circumvent the use of a pump and a T tube, Wadgymar and Wu have recently recommended the direct placement of ethanol into the acid concentrate of a dual concentrate, bicarbonate-based, proportioning dialysate generating system (4). Our findings are in agreement with those obtained by these authors. However, we have also demonstrated that ethanol can be directly and safely introduced not only into 2 currently available varieties of base dialysate concentrates, but also into their respective conjugate acid dialysate concentrates for the purpose of ethanol enrichment.

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