Understanding Dialysate Bicarbonate

A SIMPLE APPROACH TO UNDERSTANDING A COMPLEX EQUATION

Fresenius Medical Care
Disclosures

- This educational program is not intended to replace the judgment or experience of the attending physician or other medical professional.
- The hemodialysis treatment prescription is the sole responsibility of the attending physician.
- Please refer to your clinic’s policies and procedures and the manufacturer’s Instructions For Use for further information.
What is Bicarbonate?

- Bicarbonate levels used in dialysis solutions are set slightly higher than normal blood levels to encourage diffusion of bicarbonate into the blood and to act as a pH buffer to neutralize the metabolic acidosis that is often present in these patients.

- Our metabolism constantly produces acids, which are normally excreted by the kidney.

- Patients on dialysis lack kidney function so neutralizing the accumulating acids has to happen during dialysis.
  - Normal concentration of bicarbonate in the body is in the range of 20 to 29 mEq/L\textsuperscript{1}.
  - For dialysis patients, the target serum bicarbonate is around 22 mEq/L, at the beginning of dialysis (pre-dialysis level)\textsuperscript{2}.


\textsuperscript{2} NKF DOQI Nutrition in Chronic Renal Failure, Vol 35, No. 6, SUPPL 2, June 2000
Two Sources of Bicarbonate

During dialysis, the patient gets bicarbonate from two sources:

1. The bicarbonate concentrate which is displayed on the hemodialysis machine.
2. PLUS acetate in the acid concentrate.
   - Acetate is quickly converted in the liver to bicarbonate; therefore, it should be counted as part of the bicarbonate that the patient gets.
Two Sources of Bicarbonate

IMPORTANT POINT:

- The value of “bicarb” that is indicated on the machine is **ONLY** from the bicarbonate concentrate.

- During dialysis, the patient actually gets a combination of acetate (which is converted to bicarb) and bicarb, resulting in what is called “total buffer” – because that bicarb + acetate “buffers” or neutralizes the acid that is produced in the body.

Two Sources of Bicarbonate

Setting the Machine

- Value is only bicarb value
  **NOT TOTAL BUFFER**
- To calculate total buffer, add 4 mEq/l for liquid concentrates or 8 mEq/l for GranuFlo® concentrates
- Ac. + Bicarb = Total Buffer* or total bicarbonate

* Total Buffer is not displayed on FMCNA 2008 Series Hemodialysis Machines
What is Total Buffer?

- Total Buffer is the bicarbonate level of what is indicated on the “Bicarbonate” reading, PLUS, the amount of acetate shown as AC on the dialysate label.

- If the “Bicarbonate” reading on the machine is displayed as 33 mEq/L and the acetate reading from the Ac reading is 8 mEq/L, the patient is being dialyzed with a Total Buffer of 41 mEq/L, which is probably high for most patients.

- Total Buffer will depend on the patient’s metabolism and the patient’s physician orders.

- Ask the ordering physician if the bicarb that is ordered is:
  - Total Buffer = “Bicarb” + “Acetate”
  - Bicarb alone without consideration for the acetate component
Example 1

- Example 1 (Liquid Acid Concentrate), one would add 3.8 mEq/L to 38 mEq/L such that the total buffer delivered would be 41.8 mEq/L.
Example 2

- In Example 2 (GranuFlo Dry Acid), one would add 7.6 mEq/L to 38 mEq/L which delivers 45.6 mEq/L of buffer.
GranuFlo & Total Buffer

- GranuFlo Dry Acid contains an additional 4 mEq/L of Di-acetate (2 acetates)
- This means a total of 8 mEq/L of acetate instead of 4 mEq/L that is contained in liquid acid from drums or gallons. This additional 8 mEq/L of acetate should be added to the bicarb amount displayed on the dialysis machine.
- Using the usual (default) bicarb liquid setting of 33 mEq/L and adding 8 mEq/L of acetate, if you are using GranuFlo, the patient will be dialyzed with 41 mEq/L of Total Buffer (This amount may be too high for many patients).
- If the physician prescribes a lower Total Buffer based on this information, you can change the displayed bicarb amount on the machine by “dialing down” the liquid bicarbonate concentration. For example, if you set the bicarbonate concentration to 27 mEq/L, the total amount of buffer in the dialysate would still be 35 mEq/L.
Effects of Metabolic Acidosis

- Metabolic acidosis is common in ESRD patients\(^1\)
- Chronic acidosis may cause:
  1. Protein-caloric malnutrition due to:
     - Skeletal muscle protein breakdown
     - Reduced albumin synthesis
     - Reduced expression of insulin-like growth hormone and growth hormone receptor
  2. Impaired glucose tolerance
  3. Altered bone metabolism
  4. Correlated with increased mortality\(^1\)

GranuFlo® Dry Acid Concentrate
Managing metabolic acidosis

33% reduction in the prevalence of acidosis (< 20 mEq/l)\(^1\)

- Normalization of uremic acidosis shown to improve patient outcomes
- Improved pre-dialysis serum bicarbonate levels
  - Decreased protein catabolism\(^2\)
  - Increased phosphorus control\(^2\)
- Management of dialysis-induced alkalosis through appropriate prescription of total buffer\(^2\)

\(^1\)FMC Patient Data Warehouse three months prior to GranuFlo® and for three months post-conversion after 60-day stabilization period.