Bicarbonate Administration

Necessary Equipment and Supplies

1. bicarbonate for IV injection.
2. IV catheter and administration equipment.
3. In-house blood gas monitoring equipment.
4. Buretrol or syringe pump are helpful, but administration manually works fine.

Safe and effective bicarbonate therapy requires the ability to monitor blood acid base status in-house. Blood gas samples must be processed within minutes in order to be accurate, so using an outside lab is not very practical. Venous or arterial blood can be assayed. Arterial samples are more valuable in cases of respiratory acidosis (cardiopulmonary compromise).

HESKA i-STAT is a cage-side portable analyzer which can provide a complete blood gas panel (venous or arterial), and is very accurate when compared to closed system arterial blood gas analysis in human hospitals. The analyzer is only a few thousand dollars, and cartridges are $5-10, depending on tests run. Cartridges are available for various combinations of electrolytes, blood gases, BUN, glucose, lactate, ionize calcium, activated clotting time, etc.

When Not to Give Bicarbonate

1. If the patient has a cause of acidosis that is essentially reversible, and is relatively stable, correct that cause first, and recheck acid-base status in 30-60 minutes. Bicarbonate therapy may not be necessary in these cases.
    a. Dehydration.
    b. Diabetic ketoacidosis – give insulin and supplement potassium and phosphorus according to the sliding scale first (see Appendix 2).
    c. Urethral obstruction that can be unblocked quickly.
    d. Respiratory compromise that can be quickly corrected (pneumothorax, some pleural effusions, obstructive foreign body, etc).

2. If the acidosis is relatively mild, fluid therapy and other supportive therapy may correct acid-base status without the need for bicarbonate supplementation. Some do not supplement bicarbonate unless TCO2 is less than 12.

3. Bicarbonate should be given with caution in severely hypokalemic and/or hypophosphatemic patients, and only after potassium and phosphate supplementation has begun. Correcting acidosis worsens both hypokalemia and hypophosphatemia. This is a problem especially in patients with diabetic ketoacidosis and renal tubular acidosis.
    a. Correcting acidosis moves both potassium and phosphorus from the extracellular fluid into the cells
    b. Insulin therapy pushes more potassium and phosphorus into the cells.
    c. Pets with RTA lose significant amounts of potassium in the urine.
    d. Phosphorus levels below 1.5 can cause hemolysis which can be potentially life threatening.
    e. Severe hypokalemia can cause weakness so profound that it can result in respiratory failure.

4. Administration of bicarbonate to patients whose acidosis can be corrected with supportive therapy and treating the cause of the acidosis can result in alkalosis. Excessive bicarbonate may precipitate clinical signs of hypocalcemia in individuals with subclinical hypocalcemia.

When to Give Intravenous Bicarbonate

1. If the acidosis is severe and will take some time to correct, bicarbonate supplementation is warranted.
    a. Severe sepsis.
    b. Ethylene glycol toxicity.
    c. Severe shock.
    d. Severe trauma with massive tissue necrosis.

2. If severe acidosis is likely immediately life threatening, bicarbonate may need to be supplemented, as there may not be time for supportive therapy to correct the acidosis prior to death.

3. Prolonged uncorrected severe acidosis can result in depression, coma/stupor and even death.

4. Some clues you may need to check blood gases, to see if your patient is acidotic.
    a. Your patient is panting very hard, without any evidence of significant cardiopulmonary disease (attempting to blow off CO2).
    b. Your patients is shocky and/or stuporous.
    c. There are indications of
        i. Sepsis
        ii. renal failure
        iii. urinary obstruction
        iv. ethylene glycol toxicity
        v. massive trauma
        vi. severe blood loss
        vii. diabetic ketoacidosis

How to Give Bicarbonate

1. calculate the bicarbonate deficit.

    mEq bicarbonate deficit = 0.3 x weight (kg) x (24 - serum bicarbonate)

2. If potassium and/or phosphorus are below normal, they should be supplemented according to Appendix 2 prior to starting bicarbonate therapy.

3. Give 25-50% of the calculated deficit over 20-30 minutes, and recheck acid-base status in 45-60 minutes.

4. If still acidotic, give another dose over 20-30 minutes. Dose depends on severity of acidosis and response to initial therapy.

5. Once acid base is stable, if there is ongoing disease which results in production of organic acids, the bicarbonate deficit can be calculated daily, and administered as a CRI in the daily fluids.

Collecting Arterial Blood Samples

1. Restrain the pet in lateral recumbency, and use the femoral artery, between the stifle and the inguinal area.

2. Prepare materials.
    a. Heparinize a 3 cc syringe, with 25 gauge needle well attached. Make sure you use the amount of lithium heparin required by your lab.
    b. If transporting the sample to the lab, have a rubber stopper from a blood sample tube as well as an ice bath ready. Also, notify the lab that the sample will be there soon, and designate a person to transport the sample. They have to be ready to run the sample immediately.
    c. If performing the test at the patient's side, have the cartridge warmed to room temperature and the analyzer on and ready to use.

3. Take the sample.
    a. Palpate the femoral pulse with index and middle fingers of one hand, with fingers approximately 1 inch apart.
    b. Introduce the needle and attached syringe into the femoral artery with the other hand, and withdraw the exact amount of blood required for the amount of lithium heparin in the syringe. Using the proper ratio of blood and lithium heparin is especially important for accurate ionized calcium results.
    c. Have an assistant apply pressure to the artery puncture site for a full 5 minutes, while assays are being run, to prevent hematoma.

4. Run the assay.
    a. If the sample is to be transported to the lab, the rubber stopper should be applied to the needle to create an airtight seal, and the sample should be placed in an ice bath for immediate transport.
    b. If the assay is to be run at the patient's side, the blood should be placed into the cartridge and sealed as soon as it is taken form the patient. The assay should be run immediately.