Pharmacy Friday

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Sodium Bicarbonate for Hyperkalemia in the Emergency Department

Introduction

1. Sodium bicarbonate was previously recommended for hyperkalemia treatment and was once considered a first-line agent for transcellular shift.
2. Studies evaluating the beneficial effects of sodium bicarbonate used an isotonic infusion commonly ~ 150 mEq/ 1000ml
3. Hypertonic sodium bicarbonate or "amp of bicarb" has an osmolality of 2000 mOsm, about 7x higher than plasma.
4. There's controversy as to whether hypertonic sodium bicarbonate is beneficial for the acute treatment of hyperkalemia due to modifications in mechanism of action.

Pharmacology	
	Sodium Bicarbonate
Dose	• 0.5-1 mEq/kg IV bolus • 50-250 mEq hr Infusion
Administration	• Hypertonic 8.4 % (50mEq/50 ml) Slow IV push over 3-5 minutes • Isotonic Infusion 1.4% (150 mEq/L): 150-500 ml/hr x 2-6 hours
PK/PD	Onset IV: 0.5-4 hours Duration IV: 4-6 hours Excretion: Urine (<1%)
Adverse Effects	Hypocalemia Injection site extravasation Intracellular acidosis (without adequate ventilation) Hypernatremia Hyperosmosis Shift O_2 release by hemoglobin
Compatibility	Incompatible with Epinephrine, calcium chloride, calcium gluconate,

Sodium Bicarbonate Proposed Mechanisms of Action	
Transcellular shift	Indirect movement of potassium into cells via an H+/K+ exchange and HCO3-/K+ cotransport.
Renal Excretion	K+ channels in the distal nephron are down-regulated by acidosis and up-regulated by alkalosis, • Sodium bicarbonate→ Alkalization agent→ K+ Channel upregulation→↑ Excretion of K+
Dilution	Volume expansion leads to less K+ per liter

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Overview of Evidence

Author, year	Design/ sample size	Intervention & Comparison	Outcome
Ngugi, 1997	Case Series n=10	Insulin- 10 unit + glucose 25g 8.4% SB- 50 ml over 15 mins Salmeterol- 0.5 mg IV Combination of each	SB led to an average ↓ **in K+ by 0.5 mEq/L drop at 30 minutes** Combination therapy with insulin/dextrose + Salmeterol **was more effective than those with SB**
Kim,1996	Observational n=12	8.4% SB-120 mEq/L x 1 hr Insulin drip- 0.5 unit/kg/min x 1 hr	SB led to ↑ of serum bicarbonate **but no change in serum K+ (6.4 mEq/L to 6.3 mEq/L)** Insulin drip led to ↓ of serum K+ (6.3 mEq/L to 5.7 mEq/L) Combination of insulin drip + SB led to ↓ in serum K+ (6.2 mEq/L to 5.2 mEq/L)
Blumberg, 1992	Observational n=12	8.4% SB (240 mEq/hr) x 1hr then with 1.4% SB (30 mEq /hr) x 5 hrs	**No change in K+ at hour 1 or 2** **↓ in serum K+ by 0.6 and 0.74 mEq/L at hours 4 and 6 respectively,** of which approximately half was calculated to be due to ECF volume expansion Peak T-waves in the ECG of 7 patients disappeared after one hour only in one patient
Gutierrez, 1991	Observational n=18	1.4% SB in H2O (1mEq/kg) over 2 hrs 8.4% SB(1mEq/kg) over 5 mins	**Isotonic SB led to ↑ in bicarbonate by 3 mEq/L and ↓ K+ by 0.35 mEq/L at 180 min** Hypertonic SB led to slight ↑ in bicarbonate and Osmolality and not change in K+ levels
Blumberg, 1988	Observational n=10	8.4% SB drip x 1 hr 1.4% SB drip x 1 hr Epinephrine drip 0.05 mcg/kg/min x 1 hr Insulin drip 0.5 unit/kg/min x 1 hr	Hypertonic and isotonic IV SB = ↑plasma bicarbonate and pH, but no impact on K+(5.66 versus 5.83 mEq/L) before vs after
Fraley, 1977	Observational n=14	SB 89-134 mEq/1000ml D5W over 4-6 hours D5W 1000ml over 4-6 hours	In SB infusion group**, serum K+ ↓ by about 0.15 mEq/L for every 1 mEq/L ↑ in bicarbonate** D5W was not effective in reducing potassium levels
Schwarz, 1959	Case Series N=4	5% SB drip over 2-6 hours	**Resolution of EKG abnormalities in all patients; 2/4 died within 24 hours**

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