TITLE: HEMODYNAMIC AND METABOLIC EFFECTS OF SODIUM BICARBONATE, CARBICARB AND HYPERTONIC SALINE IN LACTIC ACIDOSIS

AUTHORS: E. Benjamin,M.D., J.K. Wang, M.D., A. Abalos, MS, A. Klapholz,M.D., J.Oropello,M.D., T.J. Iberti, M.D.

AFFILIATION: Depts. Surg. & Anes., The Mt. Sinai Hospital, New York, NY 10029-6574

The use of sodium bicarbonate ($NaHCO_3$) in lactic acidosis is controversial. $NaHCO_3$ has been associated with hyperosmolality due to sodium overload, hypercapnia, myocardial depression, and worsening hyperlactatemia, usually attributed to increased $CO_2$ production ($\dot{V}CO_2$). Carbicarb is an equimolar mixture of sodium carbonate ($Na_2CO_3$) and $NaHCO_3$ reported to possess excellent buffering activity, without increasing $\dot{V}CO_2$. This study was designed to compare the effects of bicarbonate and carbicarb, using equimolar (5.84%) hypertonic saline (HS) as control.

Eighteen mongrel dogs (18-25 kg) were anesthetized with pentobarbital, ventilated, and instrumented. After stabilization and baseline data recording, the dogs were subjected to controlled hemorrhage into a reservoir bag, maintaining MAP 35-45 mm Hg. After 90 min of shock, the dogs randomly received 2.5 ml/kg of a molar solution of either bicarbonate, carbicarb, or HS over 5 min. Data, including complete hemodynamics, lactate, venous and arterial blood gases, $\dot{V}O_2$, and $\dot{V}CO_2$, were recorded at 1,5,15, and 30 min, and were analyzed with repeated measures ANOVA.

Hemorrhagic shock decreased MAP, CO, $\dot{V}O_2$, $\dot{V}CO_2$,

$HCO_3^-$, and pH,while increasing lactate in all 3 groups Immediately after drug injection, MAP, CO, $\dot{V}O_2$, and $\dot{V}CO_2$ increased in all 3 groups, while lactate remained elevated. $HCO_3^-$ and pH did not change in the HS dogs. The $HCO_3^-$ and pH changes were more pronounced and longer lasting in the carbicarb group.

This study demonstrates that carbicarb is an effective buffer that raises $HCO_3^-$ and pH more than an equimolar dose of bicarbonate. MAP increased moderately and CO increased more noticeably in all dogs, probably as a result of identical sodium load. This improved hemodynamics resulted in enhanced $\dot{V}O_2$ and $\dot{V}CO_2$ in all 3 groups. However, $\dot{V}CO_2$ increased the least in the carbicarb group. In this study, bicarbonate did not depress hemodynamics. The immediate and transient nature of the hemodynamic improvement may explain why previous studies that measured these parameters later failed to demonstrate any beneficial hemodynamic effect of sodium bicarbonate.

| | Hypertonic Saline (n=6) | | | | NaHCO3 (n=6) | | | | Carbicarb (n=6)*p<0.05 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Shock | 1min | 15min | 30min | Shock | 1min | 15min | 30min | Shock | 1min | 15min | 30min |
| pH | 7.03 | 6.94 | 6.96 | 6.98 | 7.13 | 7.24*7.13* | | 7.19* | 7.03 | 7.38*7.28* | | 7.31* |
| Bic | 10.7 | 10.1 | 10.1 | 10.7 | 8.8 | 19.9*13.7 | | 16.2* | 13.2 | 22.9*19.0* | | 20.6* |
| MAP | 37 | 47 | 55 | 57 | 39 | 57 | 53 | 58 | 40 | 71* | 69 | 65 |
| CO | 1.0 | 2.0 | 1.9 | 1.6 | 0.8 | 2.2 | 1.5 | 1.7 | 1.1 | 2.1 | 1.8 | 1.9 |
| $\dot{V}O2$ | 86 | 132* | 111 | 119 | 64 | 81 | 92 | 101 | 59 | 83 | 74 | 76 |
| $\dot{V}CO2$ | 70 | 105 | 89 | 90 | 67 | 97 | 94 | 103 | 74 | 88 | 89 | 83 |
| lact | 9.6 | 10.1 | 10.6 | 9.5 | 10.6 | 11.5 | 12.5 | 11.8 | 7.6 | 8.8 | 8.3 | 8.1 |

References
1. Am J Med 1989; 87:7-14
2. Am J Med 1989; 87:5-6
3. Crit Care Med 1988; 16:779-782
4. Ann Intern Med 1986; 105:276-279

A1228

TITLE: REAL TIME ST SEGMENT ANALYSIS FOLLOWING ABDOMINAL AORTIC ANEURYSM RESECTION

AUTHORS: Donald M. Mathews,MD and Charles Weissman,MD

AFFILIATION: Departments of Anesthesiology and Medicine, Columbia University, New York NY 10032

Real time ST segment analysis for detection of myocardial ischemia is being introduced to the recovery room and intensive care unit (ICU). Presumably such monitoring will lead to improved outcome, but this has not been demonstrated. It is unclear which patients should have ST segment monitoring: all patients or only those with known coronary artery disease (CAD). The association between ICU activity and ST segment change is also not defined.

Thirty patients were studied following abdominal aortic aneurysm (AAA) resection. Following surgery, a Qmed(Clark, NJ) Monitor One TC Holter monitor capable of real time ST segment analysis was attached to the patient. Modified V5 and modified III leads were monitored for 48 hours or until extubation, if longer than 48 hours. Nursing staff pressed the event indicator button when the patient was undergoing stressful ICU procedures such as transport to the ICU, chest physiotherapy (PT), and extubation.

CAD was defined as a history of myocardial infarction, angina or Q waves on a preoperative EKG. 16 patients were in the CAD group, 14 were non-CAD. Ischemia was defined as a depression of 1mm or more from the isoelectric line, with a horizontal or downsloping ST segment, lasting for at least 40 seconds. The number of episodes, the degree of ST segment depression, the length of each episode, the heart rate during each episode and temporal association with ICU activity was determined for each patient. CAD and non-CAD patients were

compared using unpaired student T tests. P value < 0.05 was considered significant. The study was approved by the Columbia-Presbyterian Medical Center Institutional Review Board.

The average age of each group, 69 (non-CAD) vs. 68 (CAD), was not significantly different. 5 of 14 non-CAD and 4 of 16 CAD patients had no ST segment changes(NS). Of those with ST segment depression, the data is presented below:

CHARACTERISTICS OF ST SEGMENT DEPRESSION EPISODES

| | NON-CAD (n=9) | CAD (n=12) | |
|---|---|---|---|
| EPISODES/48 HRS | 7.9 ± 3.9 | 15.6 ± 4.3 | (NS) |
| AVG DURATION (min) | 12.2 ± 4.5 | 27.2 ± 9.9 | (NS) |
| TOTAL DURATION/ 48 HRS(min) | 78 ± 39 | 507 ± 225 | (<0.05) |
| HEART RATE(BPM) | 107 ± 8.8 | 89 ± 3.9 | (NS) |
| ST DEPRESSION(mm) | -1.00 ± .003 | -1.16 ± .12 | (NS) |
| % OF EPISODES ASSOC. WITH ICU ACTIVITY | 66 ± 13% | 31 ± 10% | (<0.05) |

Mean ± standard error of the mean
ICU activity most often associated with ST segment depression was chest PT, occurring in 7 non-CAD patients and 8 CAD patients. ST segment depression occurred during extubation in 2 non-CAD patients and 3 CAD patients and during ICU arrival in 2 non-CAD and 3 CAD patients.

Following AAA resection 64% of non-CAD patients and 75% of CAD patients had episodes of ST segment depression. Many of these episodes were associated with stressful ICU activity. This suggests that special attention should be paid to ST segment monitoring during these periods.Most importantly, it needs to be determined whether all instances of ST segment depression represent actual myocardial ischemia.