CARBONIC ANHYDRASE INHIBITION DOES NOT ALTER THE RATE OF RECOVERY FROM METABOLIC ACIDOSIS IN THE SPINY DOGFISH, *SQUALUS ACANTHIAS*

E.R.Swenson and J.B.Claiborne

Dept of Medicine, Univ of Washington, Seattle,WA and Dept of Biology, Georgia Southern College, Statesboro,GA.

We have previously demonstrated the participation of gill carbonic anhydrase (CA) in the correction of respiratory acidosis and metabolic alkalosis in the elasmobranch (Swenson and Claiborne,Bull.MDIBL 25:42,1985 and Swenson et al,Bull.MDIBL 24:72,1984). However the recovery from metabolic acidosis, which occurs by acid excretion or bicarbonate uptake in the gill (Heisler, in Fish Physiology,Vol 10A,pp315-400,1984) has not been studied with carbonic anhydrase inhibitors. Therefore we examined the effects of benzolamide (1 mg/kg),a CA inhibitor capable of selective gill enzyme inhibition (Swenson et al, vide supra) on the rate of recovery from metabolic acidosis and a comparable degree of metabolic alkalosis in the dogfish shark. Metabolic acidosis (ACD) and metabolic alkalosis (ALK) were induced by intravenous infusion over one hour of 1 mEq/kg HCl and 2 mEq/kg $NaHCO_3$ respectively. Samples of arterial blood were drawn hourly for measurement of pH, pCO_2, pO_2 and total CO_2 (TCO_2). Each animal served as its own control. The results are shown in the table for arterial pH and TCO_2 in four fish.

The recovery from both acidosis and alkalosis is very rapid and complete normalization of extracellular acid-base status occurs within four hours. There was no effect of benzolamide on the rate of recovery from metabolic acidosis, but a clear decrease in the rate of recovery from metabolic alkalosis. The latter finding is in accord with our earlier work which involved a much greater degree of alkalosis (9mEq/kg $NaHCO_3$). It was necessary to test this smaller degree of alkalosis in the present work because an equivalent large dose of HCl is lethal. The lack of effect of CA inhibition in metabolic acidosis is surprising since compensation to another form of acidosis (hypercapnia) is markedly slowed by benzolamide. This lack of effect might be explained by a rate of proton or bicarbonate synthesis which is sufficiently met by the uncatalyzed reaction of CO_2 and H_2O. However if this were the case then one might predict a similar failure of CA inhibition to alter the recovery from a comparable degree of metabolic alkalosis. Our new results suggest that acid excretion by the gill in metabolic acidosis is a primary process of proton formation and extrusion that occurs by mechanisms not requiring carbonic anhydrase or CO_2. In this respect, the gill may be similar to the kidney, which we have shown to be capable of high rates of acid excretion independent of carbon dioxide and carbonic anhydrase (Swenson and Maren, Am. J. Physiol. 250:F288, 1986).

EFFECTS OF BENZOLAMIDE ON THE RATE OF RECOVERY FROM METABOLIC ACIDOSIS (ACD) AND METABOLIC ALKALOSIS (ALK) IN THE ELASMOBRANCH SHARK, SQUALUS ACANTHIAS

	ACD				ALK			
	CONT		BENZ		CONT		BENZ	
HOURS	pH	TCO_2	pH	TCO_2	pH	TCO_2	pH	TCO_2
0	7.83	5.4	7.82	5.0	7.78	4.6	7.77	4.6
1	7.40	1.8	7.39	2.1	7.98	12.9	7.94	13.2
2	7.69	3.8	7.75	4.4	7.80	7.1	7.86*	11.0*
4	7.80	5.2	7.82	5.2	7.77	4.7	7.84*	8.6*

HCl or $NaHCO_3$ was infused over the 0-1 hour interval

CONT = Control BENZ = CA Inhibition with Benzolamide

* $p < 0.05$ (paired t test) CONT vs BENZ