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Title : CEREBROSPINAL FLUID BICARBONATE REGULATION IN NEWBORN LAMBS

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Introduction. Cerebrospinal fluid bicarbonate ($CSF[HCO_3^-]$) regulation under hypercapnic conditions implies in adult animals the catalyzed reactions of carbonic anhydrase and Na-K-ATPase[1]. These enzymes are located in ependymal and glial cells of the blood brain and blood-CSF barriers. It has been shown for newborn rats that maturation of these barriers occurs over a time of about 20 days after birth[2]. From the 10th to the 28th day the carbonic anhydrase activity increases about 6-fold[2]. The question remained whether newborn animals would have a similar bicarbonate generation in their blood-brain and blood-CSF barriers, as shown for adult dogs. We challenged newborn lambs with 5% carbon dioxide in 95% oxygen for 4 hours in order to determine the bicarbonate changes in blood and CSF.

Methods. 10 newborn lambs (1 to 7 days old) were anesthetized (30mg sodium pentobarbital/ kg body weight), intubated, mechanically ventilated and relaxed (0.5mg d-tubocurarine/ kg body weight). A femoral arterial and venous cut down for catheter insertion was carried out. The animal was then turned into prone position. The dural sack was exposed at the lumbar level and a 20 gauge catheter for CSF sampling inserted. After stabilization of the arterial $P\dot{c}o_2$ at 40 ± 2 mmHg for at least half an hour, the inspiratory gas mixture was changed to 5% carbondioxide in oxygen. Arterial, saggital sinus and CSF samples were taken at hourly intervals up to 4 hours of hypercapnia. The bicarbonate concentrations were calculated according to the Henderson-Hasselbalch equation.

Results. The pH values in arterial and venous blood and in the cerebrospinal fluid dropped over 4 hours of hypercapnia by at least 0.2 pH units. The corresponding Pco_2 values increased by at least 35 mmHg. The calculated bicarbonate levels showed no significant deviation from the control measurement at 100% oxygen.

Discussion. These results suggest that no additional bicarbonate is generated at the site of the blood-brain and blood-CSF barriers in newborn lambs during respiratory acidosis. Such an additional bicarbonate generation has been demonstrated for adult dogs[1]. We questionned whether there might be a species difference in this respect. We are currently studying CSF bicarbonate regulation under hypercapnic conditions in adult sheep. Preliminary results show a singificant increase of bicarbonate in CSF and blood as well (9.2 meq/l and 12.4 meq/l), with an obviously larger increase in CSF.

Conclusions. The protecting acid-base balance mechanism in the blood-brain and blood-CSF barriers which has been demonstrated for adult mammals is lacking in the newborn lamb.

References.

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