Title: THE EFFECTS OF FLUID RESUSCITATION ON BRAIN WATER CONTENT

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Introduction: Various fluids are used for volume replacement during surgery and these same fluids, e.g. whole blood (WB), lactated Ringer's solution (LP), hydroxyethylstarch (hetastarch - HS) etc. are also used during care of brain injured patients. However, we have little knowledge of the effects of such fluids on the brain, e.g. on brain edema, intracranial pressure (ICP), cerebral blood flow (CBF), etc. Therefore, as one part of such a study, we examined the effects of volume replacement with 3 fluids (WB,LR and HS) on brain water (BW) content following an experimental cryogenic brain injury in rabbits.

Methods: 18 rabbits were anesthetized with thiopental, and placed into a stereotactic frame. A 12mm diameter hole was drilled over the left posterior-lateral cortex, and cryogenic lesion produced by applying a liquid-N_2 cooled steel rod to the dura for 90sec. The bone was replaced. A catheter was placed into a femoral artery and 15min after the injury, 25% of the calculated blood volume (BV) was removed (BV= 0.05xbody weight). 30min later, this volume was replaced with: 1) an equal volume of WB (Grp. I); 2) an equal volume of HS (Grp. II); or 3) LR equal to 3 times the amount of blood removed (Grp. III). There were 6 rabbits in each group. BP was monitored for another 30 min, and the animals then returned to cages. 24 hrs later the animals were sacrificed, a blood sample obtained from the heart {for determination of hematocrit (Hct), and plasma Na^+, K^+ and osmolality}, and the brain quickly removed. Any clot or debris was discarded, and 1-2gm samples from each hemisphere (including the area around the lesion) were placed into vials, weighed, and dried for 48 hrs (80°C). The percent BW was calculated from the differences in wet and dry weights.

Results: Hemorrhage reduced mean BP from 85.0±2.2(SEM) torr to 71.9±3.7 torr ($p<0.01$), with no intergroup differences. Volume replacement resulted in post-infusion BP's of: 79.8±5.6 (Grp. I); 77.2±5.1 (Grp. II); and 72.2±7.6 (Grp. III) (differences not significant). Pre-hemorrhage Hct was 38±1% and fell to 30±1% in both Grp's II and III at the time of sacrifice ($p<0.01$). Hct in Grp. I (WB) was unchanged (39±2%). There were no intergroup differences in plasma Na^+, K^+ or osmolality.

Data on BW content of the left (lesioned) and right hemispheres of the three groups are summarized in the Table. In all cases, BW content in the right hemisphere was significantly less than in the left. However, there were no significant intergroup differences in either hemisphere. (Note: BW content in the normal rabbit brain is 79.2±0.4%).

Discussion: The cryogenic lesion described produces a form of vasogenic edema due to disruption of the blood-brain-barrier, a condition somewhat analagous to that seen after head injury. The experiment was designed to simulate acute fluid resuscitation occurring soon after the injury, and the data suggests that the use of isotonic colloid (HS) or crystalloid (LP) has no effect on BW content (i.e. brain edema) 24 hrs. post-lesion (a time when edema is usually maximal) when compared with the WB group. This implies that these agents can be used interchangeably, at least with respect to edema formation. However, transient changes in BW content may have occurred during the 24 hrs. period, and it is also possible that delayed hemorrhage and resuscitation might produce different results. Furthermore, these fluids might have very different effects on CBF and ICP (due to viscosity changes) which would not be reflected in BW measurements. This study suggests that the lesion itself is the major determinant of edema formation, and that the method of fluid resuscitation is much less important.

TABLE: BRAIN WATER CONTENTS

	Grp.I (WB)	Grp.II (HS)	Grp.III (LR)
Left	80.7±0.2	81.2±0.3	81.2±0.1
Right	79.4±0.3	80.0±0.4	79.3±0.2

(All values are %, mean ± SEM)