DATE:

TITLE: BRAIN RETRACTION PRESSURE AND CEREBRAL PERFUSION

AUTHORS: M.S. Albin, M.D., M.Sc.(Anes.), L. Bunegin, B.S., A. Marlin, M.D., P. Helsel, B.S., W. Phillips, B.A. and M. F. Babinski, M.D.
AFFILIATION: Department of Anesthesiology and Division of Neurosurgery, The University of Texas Health Science Center, San Antonio, Texas 78284.

Introduction. During intracranial procedures a major portion of our anesthetic strategy is directed to the maintenance of an optimal cerebral perfusion pressure (CPP) defined as the mean arterial pressure (MAP) noted at an intracranial reference point minus the intracranial pressure (ICP) or central venous pressure (whichever is the highest of the latter two pressures). Unfortunately, positional changes, induced hypotension (IH) and anesthetic agents affectting MAP, ICP and autoregulation may also reduce CPP in a brain already compromised because of existing pathology.

An important factor relating to cerebral perfusion that is often overlooked is the pressure exerted on brain by the application of a retractor. The use of fixed mechanically applied retraction during microneurosurgical cases of long duration brings with it the potential hazards of cerebral ischemia and infarction. Hence, during retraction we must include the brain retraction pressure (BRP) factor in our CPP equation to read CPP=MAP-CVP or BRP (whichever is the highest of the latter two pressures).

The purpose of this study is to evaluate the changes in CPP that can develop in the human subject during the application of BRP under normotension and induced hypotension.

Methods. BRP was monitored in 10 individuals undergoing intracranial procedures. Six patients had aneurysmal surgery under induced hypotension and four had tumors removed with MAP at normotensive levels. BRP was monitored using either a retractor blade fitted with a microcircuit strain gauge (the strain converted to a pressure) or an electronic switch contained in a plastic sleeve fitting over a retractor blade. Anesthesia was standardized (narcotic, muscle relaxant, thiopental) and intravenous nitroglycerine was used for blood pressure reduction.

In all cases arterial blood pressure was monitored via a radial artery catheter and the CVP by a catheter in the right atrium. Informed consent and institutional approval for this study were obtained.

Results.

NORMOTENSION

MAP(torr)	CVP(torr)	- BRP(torr) mean	= CPP (torr)
80	5	21 ± 5	59
90	8	25 ± 4	65
70	7	27 ± 6	43
74	9	20 ± 3	54

INDUCED HYPOTENSION

MAP(torr)	CVP(torr)	- BRP(torr) mean	= CPP (torr)	Duration IH (mins.)
50	2	15 ± 3	35	10
60	5	20 ± 6	40	18
45	6	17 ± 8	28	40
50	5	22 ± 5	28	65
40	3	20 ± 7	20	28
55	8	28 ± 3	27	43

Discussion and Conclusion. Extremely low CPP changes took place in the group with induced hypotension and in one patient in the normotensive group (43 torr). A knowledge of the BRP can allow for the repositioning of retractors should the pressures become highly elevated. Periodic repositioning of the retractor might also be important in light of the fact that the BRP always exceeded the CVP. In previous publications Albin and coworkers[1,2] have noted the development of brain lesions in animal studies when BRP exceeded 30 torr for one hour at normotension and when BRP exceeded 20 torr for one hour at a MAP of 50 torr or lower. In another recent animal study[3] it was demonstrated that the application of 20 torr BRP on the ipsilateral somatosensory cortex resulted in the development of 19 torr ICP on the contralateral cortex as measured by a subarachnoid screw and equally pronounced decreases in regional cerebral blood flows on retracted and nonretracted hemispheres.

We can conclude that the levels of BRP generated in this study markedly decrease CPP; that BRP should be monitored during induced hypotension; that retraction and induced hypotension should be of the shortest duration possible at the lowest BRP. Supported in part by NIH Grant #NS 15316-02.

References.

1. Albin, M.S., Bunegin, L., Dujovny, M. et al: Brain retraction pressure during neurosurgical procedures. Surgical Forum, 26:499, 1975.
2. Albin, M.S., Bunegin, L., Bennett, M.H. et al.: Clinical and experimental brain retraction pressure monitoring. Acta Neurolog. Scand.(Suppl. 64) 56: 522-523, 1977.
3. Albin, M.S., Bunegin, L., Helsel, P. et al.: Intracranial pressure and regional cerebral blood flow responses to experimental brain retraction pressure. In press: Proc. 4th International Sympos. Intracranial Pressure, Springer-Verlag, 1980.