HEAD injuries have presented a problem to physicians since prehistoric times.\textsuperscript{10,16} Most of the important works on surgery, from the first written record, the Edwin Smith papyrus,\textsuperscript{21} have contained methods for their treatment.\textsuperscript{17} Until the nineteenth century, however, the main emphasis in the treatment of skull fractures was placed on the care of the injured skull and scalp.\textsuperscript{1,11,10} Hippocrates had proposed prophylactic trepanation, but the rationale for this was not clearly expounded, and later surgeons argued its merits.\textsuperscript{10,17} It appears that the principle expressed by Rhazes in about 900 A.D.—that in head injuries compression of the brain is more important than damage to the skull—was overlooked until relatively recent times.\textsuperscript{17} In fact, according to Silvester O’Halloran,\textsuperscript{11} an Irish surgeon (1728–1807), murder by blows to the head was not usually considered punishable in the British Isles in the eighteenth century unless a skull fracture could be demonstrated.\textsuperscript{10}

By the end of the nineteenth century it was recognized that cerebral contusion and edema could cause increased intracranial pressure without coexisting hematomas.\textsuperscript{17} Decompressive trephining was proposed by Jaboulay\textsuperscript{9} in 1896, and in 1908 Cushing\textsuperscript{a} advised subtemporal decompression in such cases. However, as experience accumulated, decompression was performed less often.\textsuperscript{17}

Also at the end of the nineteenth century, surgeons began to perform major operations on the brain, and cerebral edema was frequently encountered.

"The relief of increased intracranial pressure during operative procedures was a problem met by various techniques. Ventricular puncture and drainage early used by surgeons was one of the most important aids in operating upon the hypertensive brain. Other less dramatic practices consisted of the use of continuous lumbar puncture drainage or the mere milking of cerebrospinal fluid from the opened arachnoid in the operative wound.\textsuperscript{10,16}" The posterior cistern was opened in procedures where lumbar puncture was inadvisable\textsuperscript{12}..."\textsuperscript{17}

Bleeding and purging had been performed in the treatment of craniocerebral injuries for centuries, and during the early development of neurosurgery various indirect methods of reducing intracranial pressure were introduced—repeated lumbar puncture,\textsuperscript{12} dehydration,\textsuperscript{6} and the administration of hypertonic solutions.\textsuperscript{14}

In 1919 the important pioneering work of Weed and McKibben\textsuperscript{19–20}

"...demonstrated the effects of intravenous solutions upon brain bulk and cerebrospinal fluid pressure. In this same year perhaps the earliest account of the clinical use of hypertonic solutions (25 per cent glucose by vein) to decrease brain volume was given by Haden.\textsuperscript{58} The oral use of hypertonic salt solutions received brief notice by Cushing and Foley\textsuperscript{[5]} in 1920, and in this same year Sachs and Belcher\textsuperscript{[14]} reported the use of intravenous salt solutions to control excessive swelling of the brain at the time of craniotomy. Further studies of the use of other salts and solutions followed."\textsuperscript{17}

Since that time it has become recognized that the temporary reduction in intracranial pressure by the use of various hypertonic solutions is frequently followed by a later "rebound overshoot" in pressure when the effect of the solution becomes dissipated.\textsuperscript{13,22}

However, hypertonic solutions have become widely employed in the treatment of intracranial hypertension, and the search for better agents continues.

References


EXPERIMENTAL ALTERATION OF BRAIN BULK*

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In the early stages of an investigation of the factors underlying the swelling (edema) of the brain in acute infections or injuries, attention was directed to the possible relationship between the volume of the brain and the alteration in the pressure of the cerebro-spinal fluid, following intravenous injections of solutions of various concentrations (1). For in the study of cerebral edema, but little progress has in the past been made on account of the difficulty of experimental approach. This condition remains today one of the great problems in pathology of the central nervous system.

The marked changes in the pressure of the cerebro-spinal fluid, reported in the foregoing paper, were quickly found to have a definite relation to the resultant volume of the brain. Thus, following intravenous injections of strongly hypertonic solutions which markedly lowered the pressure of the cerebro-spinal fluid, definite shrinking of the brain occurred. And conversely the brain bulk was appreciably increased by the intravenous injection of hypotonic solutions, which raised the pressure of the cerebro-spinal fluid. Such changes in the size of the brain are rapidly and uniformly brought about, giving definite information as to one phase of the physiological regulation of the volume of this organ.

METHODS

Cats were used entirely in this work. Intravenous injections of the various solutions were given with a syringe or with a burette connected directly with a fore-leg vein. For the hypertonic solutions, 30 per cent sodium chloride or saturated sodium bicarbonate in distilled water were given, as previous work had demonstrated their

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