HYDROCEPHALUS
A CONTRIBUTION RELATED TO TREATMENT

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The following paper was read before the American Neurological Association in 1942 and appears in abstract form in the transactions of that year. I decided not to publish the original paper, however, until further clinical tests could be made. In pursuing the problem of congenital hydrocephalus I have arrived at conclusions that no doubt many others have deduced. It is only in the occasional and well selected infant having an otherwise reasonably normal brain that one can hope to have any gratifying success regardless of the method used. Successes in the treatment of congenital hydrocephalus are few and far between. This paper is presented, however, in its original form since it is felt that the reasoning is sound and that there is no other method of treatment at present that is superior to the one herein described. Moreover, my interest has been considerably augmented by the result in treatment of a child who acquired severe communicating hydrocephalus as a sequel of pneumococcc meningitis. The case and discussion are presented as an addendum to the original paper.

Hydrocephalus has been a challenging and almost insuperable problem to the neurological surgeon. With a clear understanding of the origin, circulation and absorption of cerebrospinal fluid it has seemed incredible that a more satisfactory method of treatment has not been devised. The obstacles, however, have proved to be great. There have been two general methods of surgical treatment. (1) Some procedure designed to establish an absorbing mechanism for the cerebrospinal fluid. Every conceivable idea has been put

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† A clarification of terminology appears to be advisable if only to avoid a misinterpretation of my own statements. The term hydrocephalus means literally "water head" and has at times been used loosely to designate any case of dilated ventricles. I would prefer to restrict the usage of the term to only those cases in which a dilatation of the ventricles results from an obstruction to the circulation and absorption of the cerebrospinal fluid—back pressure. Dilated ventricles that result from congenital malformations of the ventricles themselves or from atrophy of brain substance without back pressure should be designated only as dilated or enlarged ventricles in order to imply a distinction relative to the causal factor. Back-pressure hydrocephalus might be designated obstructive hydrocephalus and would be correct, but I believe it would imply to many a ventricular-aqueductal obstruction. All back-pressure hydrocephalus is obstructive and the obstruction may be anywhere from the place of formation of the ventricular fluid to its place of absorption. The terms communicative and non-communicative, because of their common usage, would suffice to designate respectively whether the obstruction is distal or proximal to the foramen of Magendie, or more specifically the cerebellar cistern. Acquired and congenital hydrocephalus are sufficiently distinguishing terms. The former is overwhelmingly the result of neoplasia while the latter is seldom so. Yet hydrocephalus may be acquired in adult life as a result of adhesive arachnitis and hence present much the same surgical problem as does congenital hydrocephalus. When using the term hydrocephalus I intend to imply the type caused by lesions other than expanding masses unless otherwise specified.
to test. To mention a few—silk threads or tubes have been extended from the ventricles to the tissues of the scalp or to the muscles of the neck; tubes have been extended from the dural cul-de-sac into the peritoneal cavity (for communicating hydrocephalus). Cushing originated this idea and tried it in six cases. The patients succumbed and because they appeared to have intussusceptions at autopsy, Cushing (erroneously) thought the spinal fluid might contain too great a concentration of pituitrin to make the procedure feasible. I placed a silver tube from the dural cul-de-sac to the peritoneal cavity in an infant, and it served its purpose well but the infant later expired with hyperthermia.

The ideal objective would be the establishment of an artificial communication from ventricle to some available subarachnoid space of the brain. This has chiefly taken the form of an artificial opening in the floor of the third ventricle with the hope of making a permanent communication from that ventricle to one of the basilar cisterns. This method would be entirely futile in the event of an adhesive basilar arachnitis. There have been some successes,¹ more so in adults,² but on the whole, and particularly in infants, the method is unsuccessful because, as is true of all such methods where openings are made from the outside into a ventricle, the integrity of the arachnoid is disrupted and the ventricular fluid is not forced into the subarachnoid space but into the subdural space. This is one reason that openings into the ventricles through the corpus callosum were failures. The method would no doubt be more successful if the opening was made from a ventricle into the subarachnoid space (from inside out) while preserving the parietal arachnoid and assuming that such an artificial opening would not later close.

(2) In any case, the failures led surgeons to another type of treatment* designed to diminish or abolish the production of ventricular fluid by destruction of choroid plexus. The plexuses in the lateral ventricles are the only ones that lend themselves to a reasonably feasible attack. If they are completely destroyed, a considerable amount of plexus still remains in the third and fourth ventricles. Nevertheless, this method has in late years proved to be the most successful yet. Dandy¹ in 1918 removed the plexuses but it was done through an air cystoscope which necessitated removal of the ventricular fluid for a time and though the fluid was quickly replaced, the mortality must have been high especially when the ventricles were so large that the brain tended to collapse. I used the method in five cases, and no matter how quickly the ventricular fluid was again replaced they were all fatal. On the other hand, if the ventricular fluid is not withdrawn, the procedure is seldom fatal. This requires a lens system however. The lens system used in conjunction with bipolar electrodes with which the plexus is cauterized appears to be the most successful method yet devised in terms of results.³,⁴,⁵,⁶,⁷

* All more conservative methods to date, such as dehydration, are admissions of defeat and could not possibly be maintained. Decompressions and repeated spinal or ventricular punctures when intended as definitive treatment are obviously not physiologically sound and should be discouraged.