Five-Year Comparative Study of Hydrocephalus in Children With and Without Operation (113 Cases)*

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HYDROCEPHALUS long has been recognized by neurosurgeons as a sign of serious intracranial disease involving obstructions in the pathways of the cerebrospinal fluid. Multiple etiologies of such obstructions have been identified, but some of the major pathophysiologic mechanisms of the cerebrospinal-fluid system in hydrocephalus remain in doubt and under investigation. Progressing hydrocephalus, whatever its cause, produces unequivocal loss of cerebral mass, however, and presumably results thereby in damage to the brain in addition to the damage caused by the process producing the blockage of the cerebrospinal fluid. Neurosurgical operative techniques recently have been developed to such a degree of technical excellence, however, that progressing hydrocephalus can be arrested by relatively simple surgical techniques, providing adequate postoperative follow-up of such patients is maintained. Thorough study of a significant group of such patients over a long period of time should give some information as to the value of such procedures in preventing brain damage that otherwise might produce an incompetent individual. For reliable conclusions, such a series of surgically treated patients should be compared with a parallel series of patients not operated upon, especially in regard to functional status of the patients.

With this objective in mind, a study has been carried out over a 5-year period in which two groups of patients with hydrocephalus have been followed simultaneously. In one group, operative treatment of progressing hydrocephalus was carried out as early as possible, and in the other group no operative procedure at all was carried out. This report compares the initial results in these two groups over the first 5 years of this study on 113 hydrocephalic children. The morbidity, mortality, functional status, and factors related to these are compared in the two groups.

Methods

This investigation is based on 113 patients with hydrocephalus, ranging from premature infants to children 13 years of age. All of these patients were seen on the Neurosurgery or Pediatrics Services at the University of Washington Affiliated Hospitals, including the University Hospital, the King County Hospital, and the Children’s Orthopedic Hospital. In all instances the patient was worked up on the Neurosurgery Service or the Pediatrics Service initially in order to determine the etiology of the hydrocephalus, its state of progression, and its state of activity. At this point a decision concerning whether operation should be carried out or not was made by the neurosurgeon consulted or the neurosurgeon handling the patient. Certain criteria were set up initially to determine whether operation was warranted or not, but these were abandoned later. The work-up of all the children to the point of deciding about operation, however, was essentially the same in each case.

Group Without Operation. The 48 patients in this group were worked up thoroughly in the hospital because of enlarging head or enlarging head and myelomeningocele. The initial work-up consisted of complete neurological evaluation, circumference of head,
measurements of chest and body compared periodically to the standard charts, transillumination, roentgenograms of skull and spine, recordings of intraventricular pressure, followed by pneumoecephalographic or ventriculographic air studies, as indicated, to determine the etiology of the hydrocephalus and its degree of progression. In some of these instances the initial air study was all that was done in the hospital concerning the state of progression of the hydrocephalus. In other instances periodic measurements of intraventricular pressure were achieved as well as repeated air studies prior to the decision that no operation was warranted. Some of the neurosurgical staff seldom advised operation at any stage of hydrocephalus, preferring to adopt a conservative approach, and this situation automatically produced this nonoperative group.

Follow-up examinations on these children were obtained over a period of 5 years with considerable difficulty in some instances. However, every child was examined by one of the authors on periodic follow-up examinations or by local qualified professional personnel when great distances were involved. Neurological evaluations at those examinations included roentgenograms of the skull and measurements of the head. Few "progress" air studies were possible, however. The frequency of these examinations varied, but were as often as every 6 to 8 months.

Periodic psychologic testings were done by trained psychologists in both the operative and nonoperative groups in similar manner. In the very young children, developmental quotients (D.Q.) were determined using the Peabody Picture Test and Gesell Developmental Scale, depending somewhat on the particular child and its age. With appropriate age of the children, intelligence quotients (I.Q.) likewise were determined, administering the Stanford-Binet and Wechsler Intelligence Tests. The frequency of testing varied, based on three criteria: a) according to changing development—every 3 months; b) when stabilized—6 months to 1 year; c) whenever insult was suffered—during acute phase and if possible 6 weeks later.

The fate of those who succumbed during the 5-year period was determined either by observation at autopsy or by securing the death certificates or autopsy reports if the patient died outside the hospital.

Group With Operation. There are 65 patients in this group, most of them brought to the attention of the neurosurgeon very early in their hospital course. Complete neurological evaluation, critical measurements of the body, records of intraventricular pressure, roentgenograms of the skull, and specific differential air studies of the brain were carried out sequentially. A definite diagnosis of the site of block was established by air study in each instance. The progressive nature of the hydrocephalus was studied by serial ventricular pressures, air studies, and measurements of the head. In many instances a ventricular study of clearance of RISA was helpful in determining the activity of the hydrocephalus. Measurements of the width of the cerebral mantle were obtained as early as possible by the air studies. If these studies demonstrated the etiology of the hydrocephalus and indicated that a progressing, nonarrested hydrocephalus was present, operation was deemed warranted. If the children were in adequate shape for a shunting procedure, such was carried out promptly and at times very early in life, including premature babies. In those children with myelomeningocele, ventriculo-atrial shunting was established prior to any direct attack on the myelomeningocele. Direct operation on the myelomeningocele was done only when the mass of the myelomeningocele was painful or cumbersome for purposes of rehabilitation. The first operative procedure in all but a few instances was a standard ventriculo-atrial shunt using the Pudenz-Heyer valve. In the small infants, the small 1 mm. cardiac catheter-valve was used during the last 2 1/2 years, whereas the larger one (the only one available) was used earlier in the series. Flushing devices were inserted in this type of shunt only during the last 18 months.

Postoperative follow-up was prolonged and repetitive, including CO₂ "bubble"