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Normotensive Hydrocephalus.
The Relations of Pneumoencephalography and Isotope Cisternography to the Results of Surgical Treatment*

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With 1 Figure

Summary
An attempt has been made to evaluate the prognostic value for surgery of some diagnostic findings in 15 patients with normotensive hydrocephalus. The results of CSF surgical shunting were considered in relation to the results of pneumoencephalography and isotope cisternography with $^{131}$ I HSA. In addition, the data obtained by the estimation of the transfer of isotope labelled serum albumin from CSF to blood have been considered. Ten patients showed remarkable improvement following surgery, five did not.

From the results of the present study it appears that no one of these diagnostic investigations gives a reliable surgical prognosis which may, however, be obtainable by integrating the results of the different examinations. The following combination of findings appears highly suggestive of good surgical prognosis: ventricular enlargement and everted anterior medullary velum with no signs of cerebral atrophy in the pneumoencephalogram, plus ventricular filling in the isotope cisternographic scans. The additional finding of retention of the isotope labelled serum albumin may further strengthen the prognostic information.

In 1965 Hakim and Adams drew attention to a syndrome now known as "normotensive" or "low pressure" communicating hydrocephalus. The syndrome is characterized by the association of (i) progressive mental deterioration, and gait disturbances, in some instances associated with pyramidal signs and urinary incontinence, (ii) enlargement of the ventricular system, and (iii) normal cerebrospinal fluid (CSF) pressure. Several aetiological factors are recognised: cranio-cerebral trauma, subarachnoid haem-
orrhage, endocranial infections, endocranial surgery, and ectasia of the basilar artery. It can also be found in patients without previous medical histories. Defective reabsorption of CSF is commonly regarded as the major underlying mechanism of the disorder, a view which derives support from the observed benefits of CSF shunting procedures. The experiences of recent years, however, have shown that good therapeutic results are achieved only in some of the patients presenting with the syndrome. This is not surprising when one remembers that similar clinical signs associated with ventricular enlargement can be found with cerebral atrophic processes in which there is no defect in CSF absorption.

Several investigations have been suggested and applied in order to confirm the diagnosis of normotensive hydrocephalus and establish criteria for surgical treatment. Pneumoencephalography was the first one to be used. Isotope cisternography is now widely employed. Measurement of transfer of isotope—labelled serum albumin from CSF to blood has been suggested, and a constant infusion manometric test has been developed for measurement of CSF absorption. Finally, recording of endocranial pressure has been employed. Each of these examinations can give valuable information. However, contradictory findings and opinions on their absolute and relative values are to be found. We decided, therefore, to review our own material.

Our main interest was in the prognostic values of these examinations as far as success of CSF shunting is concerned. All the investigations listed above were applied to our patients. However, the constant infusion manometric test and the recording of endocranial pressure were introduced only recently in our Institutes and our experience with them is still slight. Therefore, the present report will be limited to recording the results of surgery in patients investigated by pneumoencephalography and isotope cisternography, and reporting the data obtained by measurements of transfer of isotope labelled serum albumin from CSF to blood at the time of isotope cisternography.

Materials and Methods

Forty-one patients were examined. There were 40 males and one female, and their ages ranged from 35 to 65 years. The histories and clinical findings in all suggested a diagnosis of normotensive hydrocephalus. In 35 progressive intellectual deterioration and ataxic gait disturbances followed cranio-cerebral trauma. Similar neurological