

## The Outcome of Surgical Management of Hydrocephalus

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P Upadhyaya

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### Abstract

Results of surgical treatment of hydrocephalus using Upadhyaya Shunt in 280 children have been presented. A new system developed by the authors has been used for scoring mental performance. Sixty per cent of the 280 children were found to be educable, 15 per cent were trainable and the remaining 25 per cent were severely retarded. During the first 3 months following surgery there was no significant improvement in mental scores, but after this period, there was a trend for steady improvement upto 5 years of age.

Severity of hydrocephalus was graded on the basis of ventricle/brain ratio, worked out from pre and post operative CT scans. While majority of children (93%) with mild hydrocephalus were found to be educable or of normal intelligence, only 25 per cent of the children having severe hydrocephalus were educable. The incidence of shunt revisions was 31 per cent.

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### Key words -

**Hydrocephalus,  
C.S.F.Shunt,  
Intelligence,  
CT Scanning**

Valvular cerebrospinal fluid shunting devices have been widely used since Holter introduced the ventriculo-atrial shunt in 1951. Due to the prohibitive cost of imported shunt valves, very few hydrocephalic children in India received the benefits of shunt surgery before 1971. With the availability of low-priced indigenous shunts, a large number of children have been treated during the last 12 years [1], [2]. In majority of cases shunting procedures bring about an immediate relief of symptoms and an appreciable improvement in the behaviour of the child. However, the ultimate aim of shunt surgery is attainment of normal intellectual potential of the child. In spite of this the outcome of surgical management is quite often judged by such physical changes as diminution in head circumference, reduction in ventricular size and patency of shunt valves, factors which do not necessarily correlate with intellectual development. There is, in fact, evidence to suggest that reduction in the size of ventricles may not always go hand in hand with improvement in mental functions.

This communication presents results of surgery in 280 hydrocephalic children, in whom mental performance was assessed at different periods following shunt surgery. In 115 of these, pre & post operative CT changes and mental performance have been compared to measure the improvement brought about by surgery. Complications of shunt surgery

have been described in 572 children treated from 1972-81.

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## Material and Methods

Since 1971 over 800 hydrocephalic children have been treated at the All India Institute of Medical Sciences using the Upadhyaya Shunt Valve. Most of the children belonged to a poor socio-economic group and were comparatively late referrals.

The Institute acquired a CT scanner in 1978. In March 1979 a joint research project was started to study the correlation between the reduction of ventricular size and improvement in mental performance at varying intervals following shunt surgery. Assessment of post-operative mental performance has been completed in 280 children so far. Two hundred of these were treated during March 1979 and December 1982 and the remaining 80 cases were operated before March 1979 during the period 1971-79. Of the former group of 200, pre and post-operative CT scans and mental scores are available in 115 cases only.

### CT Scans :

Surface areas of the brain and its ventricles were separately measured with a planimeter in each of the tomographic cuts and the mean value derived therefrom. The degree of ventricular dilatation has been expressed as the ratio of ventricular area to brain area (V/B%) as suggested by Lonton [3].

$V/B \text{ ratio} = \text{Mean ventricular area} / \text{Mean brain area} \times 100$

### Mental performance quotient

A new system of mental scoring called AIIMS development schedule has been developed for studying longitudinal mental development covering motor, adaptive, language and social/personal aspects of development [2]. The system provides a quantitative evaluation of developmental changes within a short time interval of 1 month; the mental performance being expressed as a quotient (M.P.Q). Its validity has been tested in 250 normal Indian children of varying ages. Based on measured levels of mental performance, normal intelligence and mental retardation have been classified into the following categories :

Pre-school children (0-5 yrs) with M.P.Q. of 50-70 can develop social and communication skills. In fact, they have minimal retardation in motor and adaptive skills, which may not be distinguished from normal until later age.

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## Results

### Mental performance following surgery

Table I comprises two groups. Group I includes 200 children operated during 1979-82. More than half the children (55.5%) in this group had an M.P.Q. of above 50, which means that they are either educable or intellectually normal. The remaining 44.5 per cent had moderate to severe mental retardation. Since the mean post-operative period in this group is 10.82 months only, it is expected that

the M.P.Q.'s will improve further in some of them as time passes. In group II there are 80 children treated during 1971-82; mean post operative period being 5 years 3 months. In this group a larger number of children (67.5%) have M.P.Q. above 50. If we see the overall performance of both the groups, broadly speaking, we can say that 62.5 per cent are educable, 14.5 per cent are trainable and 23.5 per cent are severely retarded.

*Table I - Percentage of cases in different categories of post operative mental performance quotient (M.P.Q.)*

***Table I - Percentage of cases in different categories of post operative mental performance quotient (M.P.Q.)***

Group I: Children treated during 1979-82. Post operative period ranged from 0.5 months to 3 years 3 months (Mean 10.82 months)

Group II: Children treated during 1979. Post operative period ranged from 7 months to 12 years 6 months (Mean 5 years 3 months)

### **Longitudinal study of mental performance following surgery**

Results of longitudinal follow up study of 280 cases given in table II, indicate that no significant improvement in M.P.Q. is expected for the first 3-4 months after surgery. Following this there is a steady improvement upto 5 years of age.

*Table II - Longitudinal study of post operative mental performance (M.P.Q.) in 285 cases followed till 1982*

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### **CT changes & M.P.Q. following surgery**

Table III has divided hydrocephalus into five groups of increasing severity as determined by the V/B ratio. Ninety three percent children with mild hydrocephalus (V/B ratio 0.20) have M.P.Q. above 50. In contrast to this only 25 per cent with severe hydrocephalus (V/B ratio 60-80) are educable. The last column in table III gives percentage of children with M.P.Q. more than 50.

*Table III - Percentage of cases in different categories of post operative V/B ratio and M.P.Q. in 115 cases*

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### **Complication of Shunt Surgery**

Case records of 572 hydrocephalic children treated at the AIIMS during the period 1972-81 have been reviewed by Bhatnagar et al [5]. One hundred seventy seven (30%) of the children needed a total of 350 shunt revisions. The types of complications noticed are listed in table IV.

*Table IV - Complications of Shunt Surgery in 572 children treated during 1972-81*

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*.CT scans of a 5 month old child. - 1a. Pre-operative CT scan showing marked ventricular lucency and*

*posterior fossa cyst*

*.CT scans of a 5 month old child. - 1b. CT scan 7 months later shows marked reduction in ventricular size. Latest M.P.Q. is still 45.26*

*.CT scans of a 1 ½ month child. - 2a. Pre-operative scan showing gross dilatation of ventricles*

*.CT scans of a 1 ½ month child. - 2b. Post operative CT scan 3 months later shows normal size ventricles with catheter in the right lateral ventricle. Latest M.P.Q. done on 11.9.82 was 104*

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## Discussion

Although shunting procedures bring about an immediate improvement in the condition and behaviour of the child, long term results of shunt surgery show a rather disappointing picture [6]. Only a small number of children are able to attain a full intellectual potential which could allow good educational grades and excellence in professional pursuits.

Observations of this study reveal some interesting facts. Although the ventricular size may be reduced following surgery, varying grades of residual dilatation persist in most of the cases. While children with smaller ventricles tend to have better M.P.Q.'s, some children with larger ventricles (V/B ratio 41 to 60%) have near normal mental scores. What is more difficult to understand is the fact that some children who have had significant reduction in ventricular size after surgery do not show commensurate improvement in mental functions. Eight of the 25 children in whom V/B ratio remained unchanged showed improvement in intellectual status.

Brain damage in hydrocephalus is a multi-factorial condition. The nature and duration of hydrocephalus, timing of shunt surgery and functional status of shunt valve can all influence the outcome of surgery. Most of the children in this series were late referrals and came from poor socio-economic group and, therefore, had significant brain damage to start with.

Portney & Chopp [7] have discussed the relationship between C.S.F. and have emphasized that increased intracranial vascular dynamics, particularly loss of auto-regulation. Is it possible that in the case of children who do not do well following surgery the cerebrovascular compromise continues in spite of a functioning shunt? In other words, is the so called "well functioning" Shunt Valve really successful in restoring the intracranial fluid dynamics to normal in every child? Also, we do not have precise methods of identifying an indolent shunt. Quite often in this study, sudden deterioration in M.P.Q. following a period of initial improvement after surgery, has indicated the need for shunt revision.

Based on the experience gained it is suggested that serial assessment of mental performance and repeated CT scan constitute the most reliable methods of effective follow up of shunt treated hydrocephalic children. For a precise definition of the outcome of surgery in hydrocephalus, it is very necessary to have a universally agreed method of measuring the CT changes and mental performance following shunt surgery. Children with post operative V/B ratio of less than 40 seem to have a 75 per cent chance of having a near normal intelligence. Children with severe hydrocephalus (V/B ratio 60-80, on the contrary have a 75 per cent chance of being mentally retarded. In the intervening group of moderately severe hydrocephalus (V/B ratio 40 to 60) there are equal chances of having a retarded or an educable child.

It will be unfair to attribute this dismal outcome entirely to the "Shunt". There is need to develop a

better understanding of intracranial patho-physiological changes particularing cerebro-vascular hydrodynamics in shunt treated hydrocephalus. There is also an urgent need to develop more refined criteria for selection of cases for surgery and for identifying indolent or malfunctioning shunts.

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