Cerebrospinal fluid diversion in the treatment of benign intracranial hypertension

IAN JOHNSTON, M.B., CH.B., F.R.C.S.,
MICHAEL BESSÉ, M.B., B.S., F.R.A.C.S., F.R.C.S.(C), AND
MICHAEL K. MORGAN, M.B., B.S., F.R.A.C.S.

Department of Neurology and Neurosurgery, The Children’s Hospital, and Department of Neurosurgery, Royal Prince Alfred Hospital, Sydney, Australia

Thirty-six patients from a consecutive series of 41 patients with benign intracranial hypertension (BIH) were treated by cerebrospinal fluid shunting. In 12 patients this was selected as the primary treatment due to the severe deterioration of vision or concern regarding the possible adverse effects of steroids; all 12 patients showed rapid and complete resolution of the disease, although eight patients still have a shunt in place. In 24 patients a shunt was inserted when other forms of treatment failed; all of these patients showed rapid resolution of the condition, although 20 patients still have a shunt in place. Three patients had the shunt removed without sequelae, and one patient in whom the shunt was removed because of low-pressure symptoms remains symptomatic with persistent papilledema (over 6 years). The percutaneous lumboperitoneal (LP) shunt was associated with the lowest revision and complication rates. Cisternal shunting to either the atrium or pleural cavity was next most effective, whereas valved LP shunts inserted via a laminectomy were least effective; ventricular shunts were used in only two cases. Shunting is therefore very effective in the treatment of BIH, but the significant complication rate and the possibility of inducing shunt dependence must be recognized.

KEY WORDS - benign intracranial hypertension • cerebrospinal fluid shunt • lumboperitoneal shunt • cisternoatrial shunt

In the absence of a clear understanding of the disease mechanism in benign intracranial hypertension (BIH), approaches to treatment of this disorder necessarily remain empirical and indirect. Moreover, evaluation of the various forms of treatment is hampered by variations in the progression of the disease and by the absence of a sufficient body of information on the natural history of the untreated condition. A recent review of treatment in a large series of patients covering a period of over 35 years highlighted the variable effects of the standard forms of treatment and also exemplified the not infrequent discrepancy between satisfactory control of signs and symptoms and the restoration or otherwise of a normal cerebrospinal fluid (CSF) pressure. The conclusion drawn from this study was that steroids should be the first line of treatment and in the event of failure or recurrence a lumboperitoneal (LP) shunt should be inserted as the next step. In that study, however, only a small group of patients was treated by shunting, making assessment of that technique unsatisfactory. Some authors are clearly opposed to the use of steroids for treating BIH and in some large series no patients were treated by shunting.

The past decade has seen the development of support for the concept of an increase in CSF volume as the underlying cause of BIH. If this is so, shunting is the most rational form of treatment in the absence of any more direct method of influencing CSF dynamics and has indeed proved to be rapidly effective in cases reported to date. There is, however, no detailed study of the use of shunts in patients with BIH, and no attempt has been made to analyze the problems associated with this form of treatment. Shunting would certainly seem to be a rational approach to treatment, particularly if a group of patients with an unremitting form of the disease could be identified. The present paper examines the efficacy of CSF shunting in the treatment of BIH, as well as the implications of the results of shunting for the nature of the disease process.

Clinical Material and Methods

The 41 patients included in this study represent a consecutive series of patients with the clinical diagnosis of BIH treated by the authors over a 10-year period from 1977 to 1986. Two patients who were treated by one of the authors prior to 1977 but who presented...
with further symptoms after that time are included. One patient who received a major part of her treatment elsewhere has been excluded from the study. For purposes of analysis, the patients are divided into the following three groups: Group I: no shunt; Group II: primary shunting (shunting as the first treatment); and Group III: secondary shunting (shunting after other forms of treatment have failed).

The high proportion of patients treated by shunting in this study reflects the author’s view that BIH is a disorder of CSF circulation and is therefore most logically treated by CSF diversion. It also attests to the fact that the long-standing interest of one of the authors (I.J.) in this condition has led to the referral of a high proportion of refractory cases not responding to medical treatment. Nevertheless, it is acknowledged that those patients in the present study identified as having reasons for either primary or secondary shunt insertion might be treated quite differently in other hands.

The clinical details for these subgroups and the whole group are summarized in Table 1. Treatment details for each of the subgroups will be considered first, after which the different forms of shunt used will be analyzed.

Results

Group I: Non-Shunted Patients

Five patients with BIH were not treated with shunting. The clinical and investigative findings are summarized in Tables 1 and 2. Two patients had an obvious predisposing cause: tetracycline usage in one and vitamin A excess in one. Two of the five patients did not have papilledema, but one was an infant with a bulging fontanelle and abnormal rate of head growth and both had measured elevation of CSF pressure (on continuous intracranial pressure (ICP) monitoring in one case and on two lumbar punctures in the other). Two of the five patients did not receive any treatment (other than cessation of tetracycline in one), and both showed relatively rapid and complete resolution of signs and symptoms. Two patients were treated with steroids. In one case there was resolution of the elevated ICP, although the patient developed frank psychotic symptoms which necessitated early curtailment of treatment. The other patient treated with steroids was an 8-year-old girl with a long history of vitamin A excess (administered by her parents for dietary reasons). In her case, there was an initial resolution within 2 months, but recurrence followed cessation of the steroids. A repeat course of steroids was given with a further recurrence after cessation (at 5 months). An LP shunt was recommended, but was refused by the parents. Her condition gradually settled over a prolonged period without further treatment. In the fifth patient the condition resolved with a course of Diamox (acetazolamide).

Group II: Primary Shunting

Twelve patients with BIH had a shunt placed as primary treatment. The clinical and investigative findings are summarized in Tables 1 and 2. Predisposing conditions were noted in two of the 10 female patients: a minor head injury in one and in the other unilateral internal jugular vein obstruction secondary to sepsis after prolonged intravenous catheterization as a sequel to gastric stapling for severe obesity. One female patient...
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| TABLE 2 |
| Investigative findings in 41 patients with benign intracranial hypertension* |

<table>
<thead>
<tr>
<th>Factor</th>
<th>Group I</th>
<th>Group II</th>
<th>Group III</th>
<th>Total Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Normal</td>
<td>Abnormal</td>
<td>Normal</td>
<td>Abnormal</td>
</tr>
<tr>
<td>Normal</td>
<td>5</td>
<td>0</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>Abnormal</td>
<td>0</td>
<td>5</td>
<td>24</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>5</td>
<td>5</td>
<td>36</td>
<td>0</td>
</tr>
</tbody>
</table>

* Group I: no shunt; Group II: primary shunting; Group III: secondary shunting; CSF = cerebrospinal fluid.

| TABLE 3 |
| Types of initial and final shunts and revision rates* |

<table>
<thead>
<tr>
<th>Type of Shunt</th>
<th>Group II</th>
<th>Group III</th>
</tr>
</thead>
<tbody>
<tr>
<td>initial shunt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>percutaneous LP</td>
<td>9</td>
<td>16</td>
</tr>
<tr>
<td>valved LP</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>cisternoatrial</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>final shunt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>percutaneous LP</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>valved LP</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>cisternoatrial</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>VP/VA</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>none</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>no. of revisions</td>
<td>7</td>
<td>43</td>
</tr>
<tr>
<td>no. of shunt years</td>
<td>30</td>
<td>98.5</td>
</tr>
<tr>
<td>revision rate</td>
<td>1/4.3 yrs</td>
<td>1/2.3 yrs</td>
</tr>
</tbody>
</table>

* Group II: primary shunting; Group III: secondary shunting. LP = lumboperitoneal; VP = ventriculoperitoneal; VA = cisternoatrial.

had diabetes mellitus which was thought to be an unrelated abnormality. In the two male patients BII was a secondary development: in one BII occurred after repair of a defect in the posterior petrous temporal bone which had been associated with two episodes of bacterial meningitis and in which the sigmoid sinus was probably compromised, and in the other BII developed after a long course of steroids for renal disease. The only abnormal investigative findings in this group were an old parietal lobe infarct on the computerized tomography scan of one patient, obstruction of the transverse sinus in one patient, and a minor electroencephalographic abnormality in one patient.

The reasons for proceeding directly to shunting were:
1) severity of papilledema and associated visual symptoms in nine patients, and
2) concern about the possible adverse effects of steroids in three. Of the second group, one patient had severe diabetes mellitus, one was at puberty, and one was in the early postoperative period after gastric stapling.

The type of shunt used and the outcome are shown in Table 3. In all patients there was rapid and complete resolution of signs and symptoms. In 11 of the 12 patients this occurred within 1 month of shunt insertion, usually within 1 week. In one patient who had two shunt blockages in the 1st month, resolution occurred rapidly after establishment of a third effective shunt.

There was a total of seven shunt revisions in five patients. The details are given in Table 4. As a result of these revisions two percutaneous LP shunts were converted to valved LP shunts and one valved LP shunt was converted to a cisternoatrial shunt. Apart from the complications necessitating revision, four patients had sciatic pain although in no case did this necessitate shunt revision or removal.

The shunt was removed in four patients after intervals from 6 to 30 months (in two cases after an initial period of clipping of the shunt). In three patients shunt removal was uneventful but in one patient there was a recurrence of headache and papilledema. The headache resolved spontaneously within 2 weeks but the papilledema persisted for 6 months while slowly resolving with the use of Diamox. This patient is now symptom-free, is receiving no treatment, and has normal ocular fundi.

In one patient clipping of the shunt led to a rapid return of symptoms with severe headache, papilledema, and diplopia, whereupon the shunt was reestablished. In two other patients who were well, isotope studies have been carried out in an attempt to identify whether the shunt was functioning. In both cases the shunt was still functioning and was left in situ (after 1½ and 3½ years).
Group III: Secondary Shunting

Twenty-four patients with BIH underwent shunt placement as a secondary procedure. The clinical and investigative findings are summarized in Tables 1 and 2. Predisposing conditions in male patients included two minor head injuries, two severe viral infections, and one middle-ear infection. In female patients predisposing conditions included three middle-ear infections; one patient was receiving tapering steroid dosage for treatment of leukemia. All patients had demonstrated elevation of CSF pressure either by lumbar puncture (17 patients) or ICP monitoring via a lumbar catheter (seven patients). The only other abnormalities on investigation were lateral sinus thrombosis on a dynamic radioisotope scan in one patient and delayed CSF clearance on isotope cisternography in one patient.

All patients in Group III had an extended trial of other forms of treatment prior to shunt insertion (Table 5). These included steroids (20 patients), Diamox (five patients), serial lumbar punctures (five patients), optic nerve decompression (three patients), and subtemporal decompression (two patients). In 16 of the 24 patients only one treatment modality was used; steroids in 12 cases, Diamox in two cases, optic nerve decompression in one case, and serial lumbar punctures in one case.

The reasons for shunt insertion are also detailed in Table 5. Worsening vision was observed in five cases and occurred at least 1 month after commencement of treatment. Failure to improve was recorded in 13 cases and included worsening of papilledema without concomitant deterioration of vision; this was taken as a reason for shunting as early as 3 weeks after commencement of the initial treatment. Four patients had a recurrence of symptoms after initial resolution with steroid treatment (a recurrence rate of 16.6%), and in two cases there were multiple recurrences before shunting. Two patients suffered complications referable to treatment; in one patient simultaneous development of diabetes mellitus and peptic ulceration and in another florid psychotic symptoms led to the abandonment of treatment with steroids. Four other patients had complications of steroid treatment; three developed marked features consistent with Cushing's disease, and one suffered persistent abdominal pain which resolved with cessation of steroid administration.

The type of shunt used and the outcome in Group III patients are shown in Table 3. As with Group II, all patients showed rapid and complete resolution of signs and symptoms following shunt insertion. There was a total of 43 revisions in this group, although 15 (34.9%) of these revisions were in two patients. The reasons for shunt revision are detailed in Table 6. The present distribution of shunt type in this group is shown in Table 3. In four patients the shunt has been removed, in three cases electively without sequelae (mean follow-up period 5.2 years) and in one due to severe low-pressure symptoms. This patient has remained intermittently symptomatic despite receiving Diamox over 6 years, but has refused placement of a further shunt. Her optic discs remain abnormal but her visual acuity has not changed.

Type of Shunt

Percutaneous Lumboperitoneal Shunt. Insertion of the percutaneous LP shunt was by means of the Tuohy needle technique using initially the ordinary epidural catheter from the epidural pack and more recently the James LP shunt catheter. This was the type

TABLE 5
Reasons for shunting and prior therapy in 24 patients with secondary shunting

<table>
<thead>
<tr>
<th>Reason for Shunting</th>
<th>No. of Cases</th>
<th>Steroids</th>
<th>Diamox</th>
<th>Lumbar Punctures</th>
<th>Optic Nerve Decompression</th>
<th>Subtemporal Decompression</th>
<th>Multiple</th>
</tr>
</thead>
<tbody>
<tr>
<td>failure to improve</td>
<td>13</td>
<td>11</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>vision deterioration</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>recurrence of symptoms</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>complications of treatment</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
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<tr>
<td>total cases</td>
<td>24</td>
<td>20</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>8</td>
</tr>
</tbody>
</table>

TABLE 6
Type of shunt and reason for revision in 24 patients with secondary shunting*

<table>
<thead>
<tr>
<th>Type of Shunt</th>
<th>No. of Revisions</th>
<th>Reason for Revision</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Obstruction</td>
<td>Infection</td>
</tr>
<tr>
<td>percutaneous LP</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td>valved LP</td>
<td>20</td>
<td>7</td>
</tr>
<tr>
<td>cisternoatrial</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>VA/VP</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>total revisions</td>
<td>43</td>
<td>21</td>
</tr>
</tbody>
</table>

* LP = lumboperitoneal; VA = ventriculoatrial; VP = ventriculoperitoneal.
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of shunt first used in 25 of the 36 shunted patients (Table 3). At present, 12 of these 25 patients still have a percutaneous LP shunt in place; in six patients it has been converted to another form of shunt due to complications, and in seven patients it was removed altogether (electively in six, and due to complications in one).

In total, there were 14 revisions of this form of shunt with a revision rate of 1/3.5 shunt years. The main reason for revision was obstruction in 11 of 14 instances; two patients had low-pressure symptoms, and in one the shunt migrated out of the subarachnoid space (Tables 4 and 6). There was no incidence of infection. Six patients later received a different type of shunt; this was initially a valved LP shunt in five cases and a cisternoatrial shunt in one case. Two of these six patients had persistent problems, and a ventriculoperitoneal shunt was finally placed in one case and a cisternoatrial shunt in the other.

Valved Lumboperitoneal Shunt. A Hakim LP shunt with a high-pressure valve (140 to 165 mm H2O valve opening pressure) was used in all but one patient receiving a valved LP shunt. A mini-laminectomy was carried out and the shunt was inserted after dural and arachnoid incision. The catheter was then placed into the peritoneal cavity via an incision in the left flank. This was the type of shunt initially placed in nine of the 36 shunted patients (Table 3). Four of these patients still have a valved LP shunt, two unrevised after 3 and 4 years, and two after a total of six revisions. In four of the nine, the initial valved LP shunt has been converted to another form of shunt due to malfunction (cisternoatrial in three cases and percutaneous LP in one case). In one patient the shunt was removed after two revisions due to persistent low-pressure symptoms. This patient has remained well for a 2-year period since shunt removal.

Of the seven patients who now have a valved LP shunt, this was the initial shunt in four cases and followed the unsuccessful use of a percutaneous LP shunt in three cases (due to obstruction and low-pressure symptoms). There were 23 revisions of this type of shunt with an overall revision rate of 1/1.8 shunt years.

Cisternoatrial or Cisternopleural Shunt. In all patients with placement of a cisternoatrial or cisternopleural shunt, a Hakim high-pressure apparatus was used (140 to 165 mm H2O valve opening pressure). This was inserted through the atlantooccipital membrane after a small part of the rim of the foramen magnum had been removed. The valve was then run across to an incision behind the ear and connected to an atrial catheter inserted in the standard fashion. A cisternoatrial shunt was the initial shunt in two of the 36 shunted patients: in one case because of a history of low-back pain (this patient subsequently underwent an L4–5 discectomy) and in one case due to recent abdominal surgery (gastric stapling for obesity). In both cases, the shunt has remained functional over a total of 6 years except for one revision due to the development of valve incompetence. In one of these patients, two attempts have been made at the patient’s request to remove the shunt after initial clipping, but in both instances there has been a rapid return of symptoms necessitating reconnection of the shunt (after 6 months and 2 years).

A further six patients now have a cisternoatrial or cisternopleural shunt in place of another shunt type which malfunctioned. There were nine revisions for this type of shunt for reasons detailed in Tables 4 and 6, with an overall revision rate of 1/2.3 shunt years. All patients who now have a cisternoatrial shunt in place are obese young women with a long history of BIH-related symptomatology; in none of these patients has it been possible to remove the shunt.

Ventriculoatrial or Ventriculoperitoneal Shunt. No patient had a ventricular shunt placed at the initial procedure. One patient now has a ventriculoperitoneal shunt after a total of four revisions of an LP shunt (initially the percutaneous type and subsequently the valved form). The ventriculoperitoneal shunt required one revision due to a blocked ventricular catheter after 6 months, but has since functioned well for 5 years. No attempt has been made to remove the shunt. The shunt was inserted prior to the use of cisternoatrial shunts, which would now be used in such a case. In the other patient, a ventriculoatrial shunt was inserted after a persistent problem with infection with both valved LP and cisternoatrial shunts. The ventriculoatrial shunt never functioned satisfactorily and was removed after two revisions. This patient now has a cisternoatrial shunt in place.

Discussion

In an analysis of the uses of shunting in the treatment of BIH there are several questions to be considered. The first concerns the therapeutic efficacy of the method and, as a corollary, a comparison of shunting with other current forms of treatment. Consideration should be given to the relative merits of the different types of shunt. Speculation might also arise as to what light the use of shunting may throw on the mechanism of the disease itself. Finally, does the use of shunting in BIH lead to shunt dependence, and therefore perpetuate an otherwise self-limiting condition?

While there have been numerous reports on the use of LP shunting for patients with BIH only small numbers of cases have been involved. Moreover, there has been no detailed analysis of the long-term outlook and complications of this form of treatment. Beatty has reported the use of a cervicoperitoneal shunt in BIH, and a number of patients included in other studies have been treated by ventricular shunting, although this is generally regarded as inappropriate due to the existence of small ventricles.
The most common form of treatment presently used is steroid administration over an extended period of time, often in excess of 4 weeks. It should be mentioned again, however, that some authors strongly object to the use of steroids to treat this condition. In a comprehensive evaluation of the efficacy of shunting it is necessary to take into account the shunt complications, in particular obstruction and infection, and to attempt to relate these to the not insignificant rates of failure, recurrence, and complication of steroid therapy. The long-term disease and treatment-related morbidity rates should also be taken into account, bearing in mind that shunting provides much more rapid and complete resolution of the disease process.

In the present study, shunting was effective in all 36 patients so treated, although in one case the patient is now without a shunt due to low-pressure symptoms and is again symptomatic. The overall revision rate varied from 1/1.8 shunt years for valved LP shunts to 1/3.5 shunt years for percutaneous LP shunts. There was a total of 50 revisions in 18 of the 36 shunted patients. Fifteen of these revisions were in two patients alone. The main reasons for revision were obstruction (24 revisions, 48%) with lesser contributions from low-pressure symptoms (14 revisions, 28%), infection (eight revisions, 16%), miscellaneous problems (three revisions, 6%) and sciatic pain (one revision, 2%). Eight of the 36 shunted patients are now without a shunt, although in one of these there have been persistent symptoms so that only 19.4% of patients may be said to have been “cured” by shunting. This compares with the much higher figure for steroid treatment shown in the earlier study. Twenty-eight of the 36 patients still have a presumed functioning shunt in place after intervals ranging from 6 months to 9 years. There are difficulties in attempting to compare “cure” rates and complication rates for the two forms of treatment in that the majority of shunted patients were treated after what was deemed to be failure of other forms of treatment, which usually included steroids either alone or in conjunction with other therapies. A more accurate comparison may be obtained by concentrating on the small group of patients treated by primary shunting. In this group all 12 patients had rapid resolution of signs and symptoms and four patients (33%) have had the shunt successfully removed without recurrence. There have been seven revisions (1/4.3 shunt years) and, apart from minor sciatic pain in two cases and low-pressure symptoms in one, there have been no complications. Certainly, no patient has had complications directly related to progression of the disease in the presence of a functioning shunt.

In examining the relative merits of the different forms of shunt, it must first be stressed that the numbers under consideration are small; it has not been possible to impose strict trial conditions because of the need to respond to the clinical demands in the individual case. Nevertheless, it is apparent that, while all shunts are equally effective in controlling the disease, the percutaneous LP shunt initially used by Jackson and Snodgrass has the lowest revision rate, infection rate, and complication rate. The valved LP shunt is surprisingly bedevilled by low-pressure symptoms as well as having a significant obstruction and infection rate. The cisternoatrial shunt, introduced in an attempt to minimize low-pressure symptoms, has been only partially successful although in the small numbers available it does seem to fulfill this requirement. The incidence of other complications for the cisternoatrial shunt are undoubtedly biased by its use in a “last resort” situation in two patients with intractable shunt infection problems.

Turning to the vexed question of disease mechanism in BIH, it does seem that there is increasing support at both theoretical and investigative levels for the concept of an increase in CSF volume as the immediate cause of intracranial hypertension. There is no doubt that the efficacy of shunting supports this concept, as does the effectiveness of repeated lumbar puncture. On general grounds, it might be supposed that placement of an LP shunt in patients with a diffuse increase in brain volume such as that due to cerebral edema would, at the ICP levels known to occur in BIH, predispose to significant brain displacement and possible herniation. Indeed, the practical relevance of this supposition has been dramatically demonstrated in at least one case diagnosed as having BIH (I Johnston, in preparation) as it has been with lumbar punctures inappropriately used in various clinical situations over the years. Thus, with an increase in brain volume or cerebral blood volume one would expect a temporary effect on intracranial hypertension followed by a cessation of this effect and probable complications related to brain displacement due to transient intercompartmental pressure gradients. Certainly, this is not the experience with prolonged drainage of CSF via a lumbar or cisternal shunt in BIH. Moreover, the degree of cerebral edema needed to account for the measured levels of ICP in BIH would be expected to produce disturbances of brain function. The theoretical considerations put forward by Reid, et al., to explain the absence of brain shift with lumbar shunting and the preservation of brain function in patients with BIH remain unconvincing.

A further question and one of considerable practical significance is that of shunt dependency. The continuing treatment in 28 of 36 shunted patients after a mean
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period of 3.5 years certainly compares unfavorably with an 87% cure rate achieved with steroids and with the overall cure rate of a variety of treatments in most series. Nevertheless, it must be acknowledged that, for reasons indicated earlier, the present series is biased toward patients refractory to medical management. In addition, in a number of series those patients who are symptom-free have been shown to have either persistent elevation of CSF pressure or chronic papilledema, or both. While there is as yet only a rudimentary understanding of the possible deleterious effects of "asymptomatic intracranial hypertension" there is no doubt that chronic papilledema may have adverse and catastrophic sequelae related to vision. Cognitive function impairment has also been reported in patients with long-standing BIH. Thus, it is necessary to establish to what degree it is desirable to restore ICP to normal for brain and visual function and whether the risks of chronic intracranial hypertension and chronic papilledema exceed those of the treatment modality proposed, in this case shunt placement. One possible objective could be to refine the diagnostic evaluation of patients with BIH to identify those patients who have an unremitting form of the condition and to reserve the use of a shunt for such patients.

While caution must be exercised in drawing conclusions from the present study, it seems incontrovertible that shunting from the subarachnoid space is the most rapidly and completely effective form of treatment presently available for BIH. Of the types of shunt available, the percutaneous LP shunt seems to be the least objectionable, although a trial of the cisternoatrial shunt or similar variant as the primary shunt may show this type to be superior.

There is a significant complication rate with shunting, as might be expected with shunts in other conditions and which necessitated revision in 50% of the cases in the present series. There has also been more than one revision in the majority of these patients. It is almost impossible to "weight" the complications for a comparison of the different forms of treatment. Which is less desirable: the worsening of obesity and the development of marked features of Cushing's disease in patients who may (as Corbett has pointed out) already be very concerned about their appearance, or a shunt revision to resolve a brief period of obstruction? There is also the question as to whether shunting induces shunt dependence, thus changing a potentially self-limiting condition into a lifelong problem.

In conclusion, it may be said that CSF shunting from either the lumbar or cisternal subarachnoid space has a place in the treatment of BIH. It is at least applicable to those patients who show rapid progression of visual disturbance, who are averse to or particularly threatened by the complications of steroid or other therapies, or who are refractory to other forms of treatment. It may be that, with further analysis of disease-related morbidity and treatment-related complications as well as refinement of diagnostic evaluation, the precise role of shunting in this condition will be more accurately established.

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I. Johnston, M. Besser, and M. K. Morgan

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Address reprint requests to: Ian Johnston, F.R.A.C.S., Department of Neurosurgery, The Children's Hospital, P.O. Box 34, Camperdown, New South Wales 2050, Australia.