SHORT REPORT

Shunt surgery in poor grade patients with tuberculous meningitis and hydrocephalus: effects of response to external ventricular drainage and other variables on long term outcome

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Abstract

Thirty two poor grade patients (grade 3, 20 patients and grade 4, 12 patients) with tuberculous meningitis and hydrocephalus were prospectively studied to evaluate the response to external ventricular drainage in predicting outcome after shunt surgery. All grade 3 patients underwent a shunt procedure irrespective of their response to external ventricular drainage, and an attempt was made to correlate the immediate response to external ventricular drainage to their long term outcome. Patients in grade 4 underwent shunt surgery only if there was clinical improvement by at least one grade after external ventricular drainage. Follow up (mean 23.1 months) was available for 30 patients (93%). Of the 20 patients in grade 3, seven underwent shunt surgery directly, 13 after an external ventricular drainage. In the group which underwent drainage, the immediate clinical response was improvement in six, no change in six, and death in one. Long term improvement or death occurred almost equally in all the subgroups. The immediate response to external ventricular drainage was not predictive of the long term outcome in grade 3 patients. All 12 patients in grade 4 underwent an external ventricular drainage and only one improved. The rest continued to deteriorate and succumbed to the disease. Grade at admission was the single most important predictor of good outcome ($p=0.002$) and severity of hydrocephalus had an adverse impact on outcome ($p=0.04$). The rest of the variables studied (age, duration of illness, duration of altered sensorium, CSF cell count, and CSF protein concentrations) had no effect on long term outcome. All patients in grade 3 should be given the benefit of shunt surgery without a trial of external ventricular drainage. However, patients in grade 4 should undergo an external ventricular drainage in view of the high mortality in this group.

Keywords: external ventricular drainage; hydrocephalus; tuberculous meningitis; ventriculoperitoneal shunt

Criteria for selection of patients for shunt surgery for hydrocephalus complicating tuberculous meningitis remain unclear. After the initial reports of a uniformly good outcome in these patients, there was a tendency to shunt all patients with tuberculous meningitis and hydrocephalus.¹⁻⁵ However, it soon became clear that treating the hydrocephalus did not result in a favourable outcome in all patients.^{6,7} The underlying cause for altered sensorium in this group of patients is multifactorial and cannot be attributed solely to the presence of hydrocephalus.⁸

We had previously reported the long term follow up results in 114 patients with tuberculous meningitis and hydrocephalus, all of whom had undergone shunt surgery. We had clinically graded these patients based on their neurological status at admission (grades 1-4; grades 1 and 2 being good grades and 3 and 4 being the worse grades) and found that this grade was the single most important factor in determining the final outcome.⁸ Based on the results of this study, we suggested that early surgery for hydrocephalus be performed for patients in grades 1 and 2. All patients in grade 4 had succumbed to the disease on long term follow up. We therefore recommended that these patients initially undergo an external ventricular drainage and only those patients who improved with external ventricular drainage be selected for surgery. Patients in grade 3 had a relatively better prognosis (52% mortality); we had proposed that these patients may undergo shunt surgery with or without selection based on the response to external ventricular drainage.

In the present study, we attempted to assess prospectively the predictive value of the response to external ventricular drainage on long term outcome in these poor grade (grades 3 and 4) patients with tuberculous meningitis and hydrocephalus.

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Clinical material and methods

PATIENTS

This was a prospective study and comprised all patients with tuberculous meningitis and hydrocephalus seen during the period June 1991–May 1995. The diagnosis of tuberculous meningitis was based on a combination of clinical features, CSF findings, and CT appearances. There was a total of 55 patients of which 23 were in the good grades (grades 1 and 2) and 32 in the poor grades (grades 3 and 4). In the poor group 19 were males and 15 belonged to the paediatric age group (<12 years of age). The duration from the time of initial diagnosis of tuberculous meningitis to detection of hydrocephalus ranged from four days to 36 months (mean 96.5 days). The mean duration of altered sensorium was five days (range 1 to 21 days). Nine patients (64.3%) in the paediatric age group presented with acute onset (<three weeks) of symptoms of tuberculous meningitis with hydrocephalus, whereas 61% of adult patients had a more chronic clinical course (>three weeks) before the onset of hydrocephalus.

CLINICAL GRADING

All patients were examined clinically just before insertion of an external ventricular drain or a shunt and graded into one of four grades using the grading system proposed in the previous report.⁸ In brief, the grading is as follows: normal sensorium and no neurological deficit, grade 1; normal sensorium with neurological deficit, grade 2; altered sensorium but arousable, grade 3; and deeply comatose with or without decerebrate/decorticate posturing, grade 4. They were also graded based on the Glasgow coma scale (GCS). A GCS score of 9–14 was graded as 3 and a score of 3–8 as grade 4. Alternatively, for children below the age of 2, the best motor score was used instead of the GCS. The GCS was also used in the periodic assessment of the patients.

CSF ANALYSIS

Samples of CSF collected by either the lumbar or ventricular route were sent for cell analysis, sugar, and protein; CSF was also sent for routine acid-fast bacillus smear and cultures. Samples of CSF taken at the time of shunt surgery were also sent for analysis. Correlations between CSF protein and cell count with the final outcome were studied.

IMAGING ANALYSIS

Brain CT, or ultrasound of the head in infants, was carried out to determine the presence of hydrocephalus. The degree of hydrocephalus and other features such as infarcts, basal exudates, and tuberculomas were recorded. The ventricular dilatation was estimated by using the ventricular:biparietal (VB) ratio, obtained by dividing the ventricular span through the body of the lateral ventricles by the width of the brain at this level.⁹

MANAGEMENT

Patients who were in grades 1 and 2 underwent a ventriculo-peritoneal (VP) shunt immedi-

ately. Those in grades 3 and 4 were required to undergo an external ventricular drainage initially. Under sterile conditions, a ventricular catheter was placed in the right frontal horn through a twist drill craniostomy. The catheter was tunnelled under the scalp for a distance of 3–4 cm and brought out through a separate incision and connected to a closed system which was maintained at a height of 12–15 cm above the foramen of Monro. Patients were maintained on an external ventricular drainage for 24 to 48 hours and their clinical status based on GCS recorded at regular intervals.

All patients in grade 3 underwent a VP shunt irrespective of their clinical improvement (GCS) or change in grade after external ventricular drainage. Seven patients in grade 3 underwent a VP shunt directly without a trial of external ventricular drainage, as they developed alteration of sensorium in the ward and their GCS was above 12. Patients in grade 4 were shunted only if they showed a clinical improvement of more than one grade with external ventricular drainage. After shunt surgery, patients were discharged on a standard 18 month regimen of antituberculous therapy which consisted of three or four drugs (INAH, rifampicin, ethambutol, and pyrazinamide) initially (for at least three months) and then two drugs (INAH and rifampicin) for 18 months. Dexamethasone in divided doses of 8 mg to 16 mg/day was also administered and tapered off over six weeks.

FOLLOW UP

Patients were regularly followed up at monthly intervals in the outpatient clinic whenever possible. For patients from distant parts of the country follow up was sought through postal questionnaires. Enquiries about their ability to carry out their daily activities, and scholastic performance in paediatric patients were made and based on the above information the patient's outcome was graded as for the Glasgow outcome scale (GOS).

VARIABLES ANALYSED

The following factors were analysed for their effect on final outcome: (1) age (<12 years *v* >12 years); (2) duration from onset of disease to detection of hydrocephalus (<three weeks *v* >3 weeks); (3) duration of altered sensorium (<72 hours *v* >72 hours); (4) CSF cells (<50/mm³ *v* >50/mm³); (5) CSF protein (<50 mg/dl *v* >50 mg/dl); (6) degree of hydrocephalus (VB ratio <0.5 and >0.5); (7) GCS (9–14 *v* 8–3) or GCS(motor) (4–6 *v* 1–3) just before external ventricular drainage or shunt surgery; and (8) clinical grade assessed just before insertion of external ventricular drainage or shunt surgery (grade 3 *v* 4).

STATISTICAL ANALYSIS

A χ^2 test was used to perform the analysis. When the cell value was <5, Fisher's exact test was preferred. Survival curves were obtained using the Kaplan-Meier method and the comparison was made using Wilcoxon's test.

Summary of variables and their effect on final outcome (n=30)

Variable		Final outcome		p Value
		Good (GOS 1–2)	Poor (GOS 3–5)	
Age (y)	<12	8	5	0.15 (NS)
	>12	6	11	
Duration of altered sensorium (h)	<72	10	7	0.13 (NS)
	>72	4	9	
Duration of disease (weeks)	<3	8	7	0.27 (NS)
	>3	5	10	
CSF cells (/mm ³)*	<50	3	6	0.45 (NS)
	>50	10	10	
CSF protein (mg/dl)*	<50	4	3	0.66 (NS)
	>50	9	13	
Hydrocephalus (VB ratio)†	<0.5	7	3	0.04
	>0.5	4	12	
GCS	9–14	11	5	0.01
	3–8	3	11	
GCS (motor component)	4–5	13	7	0.01
	3–8	1	9	
Grade at intervention	3	13	5	0.002
	4	1	11	

*Data available for 29 patients. †Data available for 26 patients.

GCS= Glasgow coma scale; GOS=Glasgow outcome scale; VB ratio=ventricular/biparietal ratio.

Results

FOLLOW UP

For patients in grades 3 and 4, follow up was available for 30 of the 32 patients (93%). The average duration of follow up was 23.1 months (range 8 to 52 months).

GRADE 3 PATIENTS

Seven patients underwent a VP shunt directly without a trial of an external drain. All these patients had a GCS between 12–14 and had deteriorated to a clinical grade 3 in the ward and they therefore were not subjected to a trial with external ventricular drainage. In this group one patient who had disseminated tuberculosis succumbed to the disease and one patient was lost to follow up. The rest were neurologically stable when last seen.

Of the 13 patients who underwent an external ventricular drainage, six had improved, six remained the same, and one patient died while on external ventricular drainage. Therefore of 13, 12 patients underwent shunt surgery. Among those who had undergone an external ventricular drainage and improved (six patients), one patient expired, another was lost to follow up, and the others had a good outcome (GOS 1, three patients; GOS 2, one patient). In the subgroup of patients who did not improve with external ventricular drainage (six pa-

tients), two died during follow up and the remaining four were normal neurologically at last follow up (GOS 1).

GRADE 4 PATIENTS

All patients except one in grade 4 did not improve in their clinical grade with an external ventricular drainage. They continued to deteriorate neurologically and none survived. The patient who had improved with external ventricular drainage had deteriorated from grade 1 to 4 in the ward. With an external ventricular drainage he improved in his clinical grade and therefore underwent shunt surgery. At the last follow up he had no neurological deficits and had resumed his higher studies.

A feature present in some of the patients who did not survive (eight of 16) was clinical evidence of brain stem dysfunction in the form of cranial nerve deficits and or hemiparesis before their death.

VARIABLES AND OUTCOME

The table shows the statistical analysis of the effect of some variables on outcome. Age, duration of the disease, duration of altered sensorium, CSF cell count, and CSF protein concentrations did not have a significant bearing on the final outcome of the patients. The degree of hydrocephalus (VB ratio) did have an adverse correlation with the final outcome ($p=0.04$). The clinical grading of the patient at the time of external ventricular drainage or shunt surgery ($p=0.002$) and the grading based on GCS ($p=0.01$) or its motor component (GCS(motor)) ($p=0.01$) had a significant correlation with final outcome.

The figure shows the survival curves for patients in various grades.

Discussion

One of the most common complications of tuberculous meningitis is hydrocephalus of the communicating type, which is due to the formation of thick gelatinous basal exudates around the interpeduncular and pontine cisterns in the acute stages and adhesive leptomeningitis in the chronic stages.^{7 10–13} This is reported to be more common in the paediatric age group and is usually related to the total duration of symptoms.¹² However, in several patients with tuberculous meningitis and hydrocephalus, diversion of ventricular CSF through a VP shunt does not result in a significant improvement in their condition and many die despite the intervention.^{1 2 4–7} Therefore the possibility of factors other than hydrocephalus—for instance, arteritis, ischaemia, and encephalopathy—being the cause of the altered sensorium and adverse neurological condition was considered. Thus selecting patients who would benefit from a CSF diversion procedure becomes important.

In our previous study, we found that the mortality rates for patients in grades 3 and 4 were 51.9% and 100% respectively, despite a policy of early shunt surgery for all patients.⁸ This justified a selection of poor grade patients for shunt surgery, especially for those in grade 4. We suggested a trial with an external

Survival curves for patients in grades 1–4. Survival curves for grades 1–2 are presented only for comparison with grades 3–4.

ventricular drainage as a preliminary procedure for such a selection. However, in the present study, we found that the final outcome in grade 3 patients was not related to the response noted after an external ventricular drainage. About 66% of patients in this group had a good long term outcome and this was not related to the immediate outcome with an external ventricular drainage. As some patients in grade 3 improve with shunt surgery despite a lack of a response to external ventricular drainage, all patients in this grade should be given the benefit of shunt surgery without a trial of external ventricular drainage.

The poor outcome (88% mortality) for patients in grade 4 underlines the need for these patients to undergo a trial with external ventricular drainage and response to the drainage of CSF to determine the necessity or otherwise of shunt surgery. In the previous study all patients in this grade were subjected to shunt surgery and there was a 100% mortality on long term follow up.⁸ Patients in this group also have the propensity to develop various complications of shunt surgery, such as decubitus ulcers, ulcerations over the site of the shunt components, and shunt infection.

To make the grading simple and eliminate between observer variability, we sought to incorporate the GCS into the grading system. The final outcome seemed to correlate well with the modified grading system. As paediatric patients formed a major proportion of patients in this study, application of our clinical grading or the GCS was difficult, more so in children below 2 years of age. We therefore used the motor component of the GCS in this group. This again correlated with the final outcome of these patients. It was found that a motor score of 1–3 equated with grade 4 and a motor score of 4–6, with grade 3. We therefore suggest that the motor score may be used as an alternative when

grading very young children with tuberculous meningitis and hydrocephalus.

CONCLUSIONS

As the response to external ventricular drainage does not correlate with long term outcome in grade 3 patients with tuberculous meningitis with hydrocephalus, all these patients should undergo shunt surgery. Patients in grade 4 should have a trial of external ventricular drainage and their response to external ventricular drainage should determine the need for shunt surgery. The outcome in grade 4 patients is extremely poor.

- 1 Bhagwati SN. Ventriculoatrial shunt in tuberculous meningitis with hydrocephalus. *J Neurosurg* 1971;35:309–13.
- 2 Bullock MRR, Ven Dellen JR. The role of cerebrospinal shunting in tuberculous meningitis. *Surg Neurol* 1982;18:274–7.
- 3 Deshpande DH, Bharucha EP, Mondkar VP. Tuberculous meningitis in adults: a clinicopathological study of 18 cases. *Neurol India* 1969;17:28–34.
- 4 Roy TK, Sircar PK, Chander V. Ventriculo peritoneal shunt in the management of tuberculous meningitis. *Indian J Pediatr* 1979;16:1023–7.
- 5 Singhal BS, Bhagwati SN, Syed AH, *et al.* Raised intracranial pressure in tuberculous meningitis. *Neurology India* 1975;23:32–9.
- 6 Idris ZH, Sinno AA, Kronfol NM. Tuberculous meningitis in childhood. Forty three cases. *Am J Dis Child* 1976;130:364–7.
- 7 Lorber J. Studies of CSF circulation in tuberculous meningitis II. A review of 100 pneumoencephalograms. *Arch Dis Child* 1951;26:28–48.
- 8 Palur R, Rajshekhar V, Chandy MJ, *et al.* Shunt surgery for hydrocephalus in tuberculous meningitis: a long term follow up study. *J Neurosurg* 1991;74:64–9.
- 9 Pang D, Altschuler E. Low pressure hydrocephalic state and viscoelastic alterations in the brain. *Neurosurgery* 1994;35:643–56.
- 10 Dastur DK, Pandya SK, Rao YC. Etiology of hydrocephalus in tuberculous meningitis [abstract]. *Neurology India* 1972; (suppl 1):73.
- 11 Smith HV, Vollum RL, Cairns H. Treatment of tuberculous meningitis with streptomycin (a report of MRC). *Lancet* 1948;i:627–36.
- 12 Tandon PN, Bhatia R, Bhargava S. Tuberculous meningitis. In: Vinken PJ, Bruyn GW, Klawans HL, eds. *Handbook of clinical neurology. Microbial disease*. Amsterdam, Elsevier, 1988;52:195–226.
- 13 Tandon PN, Pathak SN. Tuberculosis of the central nervous system. In: Spillane JW, ed. *Tropical neurology*. London: Oxford University Press, 1973:37–51.