

Ventriculoperitoneal shunt for hydrocephalus secondary to tuberculous meningitis: Effects of response to variables on short term outcome

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Abstract:

Objective: To determine the relationship of different factors with the outcome of ventriculoperitoneal (VP) shunting in patients with post tuberculous meningitis hydrocephalus at 3 months of follow up.

Study design: Quasi-experimental study.

Setting: Department of Neurosurgery, Dow University of Health Sciences/ Civil Hospital, Karachi.

Duration of study: Nine months and two weeks between 18th September, 2008 and 30th June, 2009.

Subjects and methods: This study was conducted in fifty patients, who were diagnosed as cases of tuberculous meningitis and hydrocephalus on the basis of history, clinical examination, CSF findings, CT and MRI appearances. All patients underwent placement of a ventriculoperitoneal shunt.

Results: Good outcome score (GOS: 4-5) was seen in thirty nine (78%) patients. Eleven (22%) had poor outcome (GOS: 1-3) along with 2 (4%) patients expired. Preoperative Glasgow coma scale (GCS) score at admission ($p < 0.001$), CSF cell count ($p = 0.003$) and presence of infarction ($p = 0.031$) were the most important predictors of good outcome. The rest of the factors studied such as age, duration of illness, CSF protein and degree of hydrocephalus (Evan's ratio) had no effect on outcome.

Conclusion: We recommend, an identifying those patients who managed with VP shunting showed improvement in the prognosis.

Key words: Tuberculous meningitis, Hydrocephalus, Ventriculoperitoneal Shunt Outcome

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Introduction:

Robert Koch discovered mycobacterium tuberculosis in 1882¹, but tuberculosis is as old as humanity itself² and was major killer in the 19th century³. The major brunt of this disease is on the third world countries with 95% in the developing countries and only 5% in the developed world because of its association with social deprivation, contact with tuberculosis patients, poverty and over crowding⁴.

Pakistan is amongst the countries with high incidence of this disease with more than 100 cases per 100,000 of the population⁵. The annual in-

fection rate is alarming at about 7%. More than 0.3 million new cases of tuberculosis are added each year⁵.

Primary pulmonary tuberculosis is about 80-85% and primary extrapulmonary tuberculosis is 17-20%. The data of admitted patients indicates that the maximum number of the latter belong to the tuberculous meningitis and disseminated tuberculosis group.

Tuberculous involvement of the brain and the spinal cord are common neurological disorders in the developing countries and have recently

shown a resurgence in the developed countries mainly due to an increasing incidence of human immune deficiency virus (HIV) infection and cases among immigrants from high prevalence countries⁶. Tuberculous meningitis is a frequent and common cause of prolonged morbidity, handicap and death among children.

In central nervous system tuberculosis, with time a thick gelatinous exudate develops around the basal meninges resulting in damage to cerebral arteries and veins, compression of cranial nerves and obliteration of the basal cisterns and ventricular foramina or narrowing of aqueduct and third ventricle by a small tuberculoma causes consequent hydrocephalus⁷.

Dilatation of ventricles and subarachnoid space is called hydrocephalus which in tuberculosis results from impaired circulation and obstruction of cerebrospinal fluid (CSF).

Obstructive or non-communicating hydrocephalus results from obstruction within the ventricles while in non-obstructive or communicating hydrocephalus CSF communicates with the subarachnoid space but is not reabsorbed into the cerebral veins. 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.

Clinical presentation of post tuberculous meningitis hydrocephalus is variable and depends on age of onset, nature of lesion, duration and rate of rise of the intracranial pressure. Diagnosis is by history, clinical findings, CSF findings and computerized tomography (CT) and magnetic resonance image (MRI) appearances. Long term medical treatment is disappointing. Most cases of hydrocephalus require extra cranial shunts, particularly a ventriculoperitoneal (VP) shunt⁸.

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 intervention⁹. Hence, factors other than hydrocephalus such as arteritis, ischemia and encephalopathy are considered as the cause of poor neurological status^{10,11}. Thus selection of patients who would benefit from a CSF diversion procedure becomes important to shunt surgery in poor grade patients with tuberculous meningitis and hydrocephalus.

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 patients following VP shunting, there was a tendency to shunt all patients with tuberculous meningitis and hydrocephalus. However, it soon became clear that treating the hydrocephalus did not result in a favourable outcome in all patients. Several criteria have been considered in the past at the time of surgery in poor grade patients with tuberculous meningitis and hydrocephalus to assess the predictive value of the response to VP shunt and external ventricular drainage with variable factors such as age distribution, duration of illness, CSF cell count, CSF protein, degree of hydrocephalus and Glasgow coma scale (GCS) at the time of intervention⁹.

In this study we plan to investigate prospectively, factors which are associated with good surgical outcome of VP shunting in tuberculous meningitis and hydrocephalus, thus selecting patients who would benefit from a CSF diversion procedure through a VP shunting.

Patients and methods:

A total of 50 patients with post tuberculosis meningitis hydrocephalus admitted through outpatient department or emergency in Neurosurgery Department, Civil Hospital Karachi from 18th September, 2008 to 30th June, 2009 were included in this study after taking informed consent. Hydrocephalus due to pyogenic meningitis, encephalitis, subarachnoid hemorrhage, posterior fossa tumour and leukemic infiltrates were excluded. The diagnosis of tuberculous meningitis and hydrocephalus was made on the basis of history of patients, clinical features, CSF

findings and CT and MRI appearances. History of patient was taken to determine the age and the duration from the time of initial diagnosis of tuberculosis meningitis to detection of hydrocephalus. All patients were examined clinically at the time of admission to assess preoperative GCS. Samples of CSF were collected by either the lumbar or ventricular route and sent for cell analysis, sugar and protein. CSF was also sent for routine acid-fast bacillus smear and cultures. Correlation between CSF protein and cell count with the final outcome were studied. Brain CT was performed to determine the presence of hydrocephalus, degree of hydrocephalus and infarction of brain. The degree of hydrocephalus was estimated by using the Evan's ratio, obtained by dividing the largest width of the frontal horns of lateral ventricles by the maximal biparietal diameter. Before VP shunting, preoperative informed consent was taken with the explanation of risk and benefit of procedure. All patients fulfilling the inclusion criteria underwent a Pudenz-Schulte medical VP shunt under general anesthesia. After sterile conditions, a ventricular catheter was placed in the right occipital horn through a burr hole. The catheter was connected with peritoneal end by medium pressure chamber. After shunt surgery, patients were discharged on a standard 18 months regimen of anti tuberculous therapy. Patients were followed up at 1st week, 2nd week, 1st month and 3rd month interval in the out patient department. Patients outcome was graded as for the Glasgow outcome scale (GOS). A GOS score of 4-5 was measuring as good and a score 1-3 as poor outcome. Final outcome was measured on 3rd month.

The whole data was collected on a proforma specially designed for this study in consultation with the experts.

After collection of proformas, the data were entered in SPSS (Statistical programme for Social Sciences) version 11.5. Relative frequencies of age distribution, duration of illness, preoperative GCS score at admission, CSF cells count, CSF protein, degree of hydrocephalus and evidence of brain infarction were obtained. Chi

square test was used to observe significant relationship between variable factors (age of patient, duration of illness, preoperative GCS score at admission, CSF cells count, CSF protein, degree of hydrocephalus and CT/ MRI evidence of brain infarction) and surgical outcome of ventriculoperitoneal shunting. $p \leq 0.05$ was taken as significant.

Results:

A total of 50 cases of post tuberculous meningitis hydrocephalus were treated by ventriculoperitoneal shunt from 18th September, 2008 to 30th June, 2009. Out of these 31 (62%) patients were males and 19 (38%) females as shown in Figure-1. Their ages ranged from 03 months to 85 years in age (mean age = 17.99 year \pm 17.20).

The decade wise age distribution is given in Table 1. This shows that a large majority of patients (42 out of 50 or 84%) were in the first three decades of life with the largest number (26%) in the third decade.

Most common presentations were with fever (78%), altered level of consciousness (50%), vomiting (42%) and headache (40%) (Table 2).

All patients had placement of ventriculoperitoneal shunts of Medtronic medium pressure 12mm burr hole type.

Surgical outcome of shunt insertion was measured by Glasgow outcome scale (GOS). A GOS score of 5-4 measured as good outcome and a score of 3-1 as poor outcome. Outcome at 3 months follow up of ventriculoperitoneal shunting

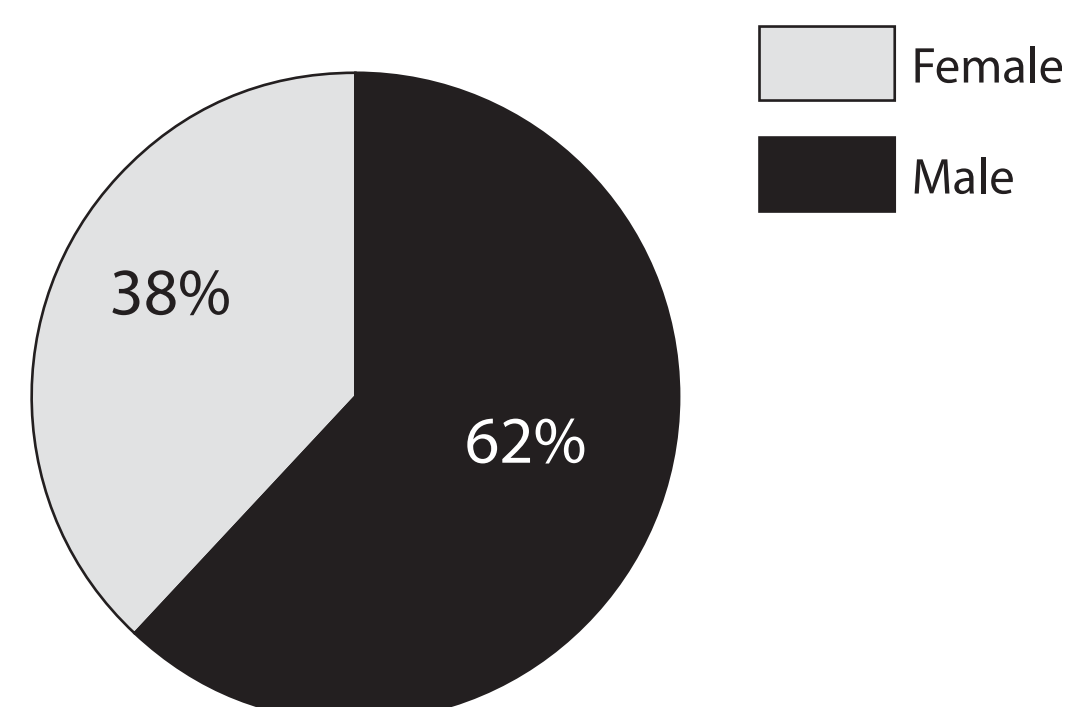


Figure 1: Sex distribution of patients (n= 50)

Table 1: Age distribution of patients

Age	Male	Female	Total	Percentage
< 1 Year	7	2	9	18
1—10 year	8	3	11	22
11—20 years	7	6	13	26
21—30 years	3	6	9	18
31—40 years	1	Nil	1	2
41—50 years	4	2	6	12
> 50 years	1	Nil	1	2
Total	31	19	50	100

(Age range: from 03 months to 85 years, Mean age: 17.99 years, Std. Deviation: 17.20 years).

in patients with post tuberculous meningitis hydrocephalus was observed as good outcome in 39 (78%) cases and poor outcome was seen in 11 (22%) cases (Figure 2).

Forty five of the 50 patients (90%) did not have any complications but five developed complications of VP shunt placement. Two of these had shunt infection which required removal and reinsertion after the CSF had become sterile. Three others developed abdominal pseudocysts which eventually led to conversion of these shunts to VA shunts.

Two patients in the series expired with an overall mortality rate of 4 %.

The relationship of age of patient, duration of illness, preoperative GCS, CSF cell count, CSF protein count, degree of hydrocephalus (Evan's ratio) and evidence of cerebral infarction was determined with outcome at 3 months follow up of ventriculoperitoneal shunting in patients with

Table 2: Frequency of clinical features of patients having post tuberculous meningitis hydrocephalus (n= 50)

Clinical Features	Percentage
Fever	78
Altered level of consciousness	50
Vomiting	42
Fits	6
Headache	40
Neurological weakness	14
Past history of TB	14
Extra-CNS TB	30
Papilloedema	26
SOMI	22

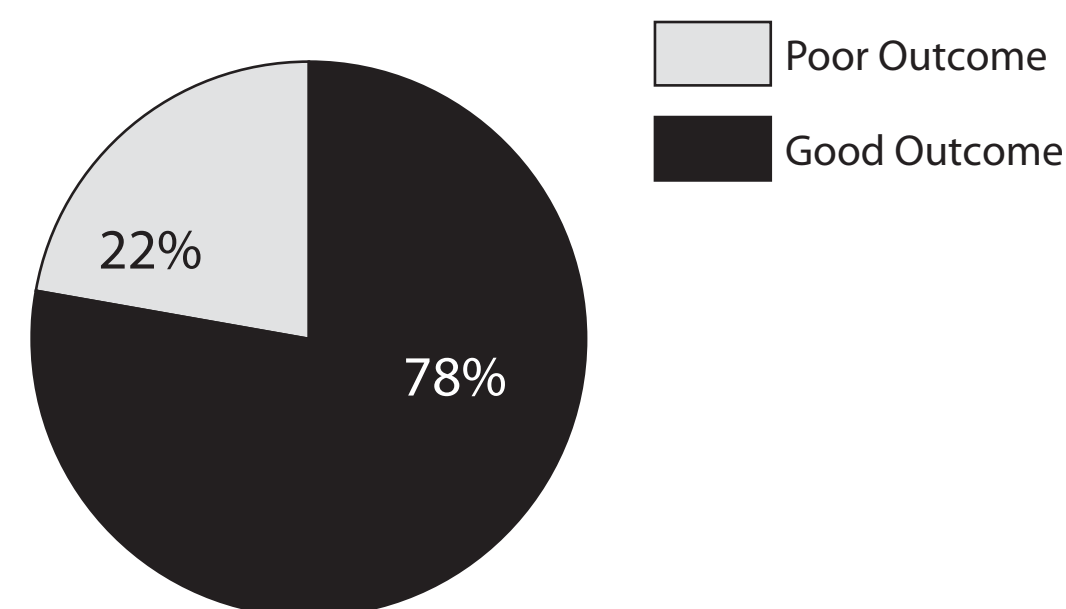


Figure 2: Outcome of ventriculoperitoneal shunting in patients with post tuberculous meningitis hydrocephalus (n= 50)

post tuberculous meningitis hydrocephalus.

Good outcome (GOS: 4-5) was seen in thirty nine (78%) patients. Eleven (22%) had poor outcome (GOS: 1-3) along with 2 (4%) patients expired. Preoperative Glasgow coma scale (GCS) score at admission ($p < 0.001$), CSF cell count ($p = 0.003$) and presence of infarction ($p = 0.031$) were the most important predictor of good outcome. The rest of factors such as age of patient ($p = 0.780$), duration of illness ($p = 0.913$), CSF protein ($p = 0.520$) and degree of hydrocephalus Evan's ratio ($p = 0.594$) had no effect on outcome as shown in Table-3.

Discussion:

Hydrocephalus associated with tuberculous meningitis is a common problem. The time honoured treatment of this complication is ventriculoperitoneal and in some cases ventriculoatrial shunts. However as shunting does not benefit all cases of hydrocephalus associated with tuberculous meningitis, efforts have been made for a long time to define criteria to select patients who will benefit from shunt insertion. One such study is that of Mathew JM, Rajshekhar V, Chandy MJ⁹. They studied 32 patients with poor grade tuberculosis meningitis with hydrocephalus (20 in grade 3 and 12 in grade 4) and studied them prospectively to evaluate the response to external ventricular drainage in predicting outcome after shunt surgery. The diagnosis of tuberculosis meningitis was based on combination of clinical features, CSF findings, and CT appearance. All patients were examined clinically and graded as follows, grade 1- normal sensorium no neurological deficit, grade 2- normal senso-

Table 3: Variables and their effect on outcome of VP shunting in patients with post tuberculous meningitis hydrocephalus (n= 50)

Variable		Outcome		Chi ² Value	p Value	Result
		Good (GOS:5-4)	Poor (GOS:3-1)			
Age (year)	<12	16 (32%)	4 (8%)	0.078	0.780	Not Significant
	>12	23 (46%)	7 (14%)			
Duration of illness (week)	< 3	10 (20%)	3 (6%)	0.012	0.913	Not Significant
	> 3	29 (58%)	8 (16%)			
Preoperative G.C.S	15 – 9	38 (76%)	5 (10%)	19.256	<0.001	Significant
	8 – 3	1 (2%)	6 (12%)			
C.S.F Cells (/cmm)	< 50	34 (68%)	5 (10%)	8.705	0.003	Significant
	> 50	5 (10%)	6 (12%)			
C.S.F Protien (mg/dl)	< 50	22 (44%)	5 (10%)	0.415	0.520	Not Significant
	> 50	17 (34%)	6 (12%)			
Degree of HCP (Evan's ratio)	< 0.5	25 (50%)	8 (16%)	0.284	0.594	Not Significant
	> 0.5	14 (28%)	3 (6%)			
Evidence of infarction	Absent	37 (74%)	8 (16%)	4.675	0.031	Significant

rium with neurological deficit, grade 3- altered sensorium but arousable, grade 4- deeply comatose with or without decerebrate /decorticate posture. CSF samples were analyzed by lumbar and ventricular route for cell count, sugar, and protein. CT scan of the brain was done, the degree of hydrocephalus and other features such as infarction, basal exudates, and tuberculomas were recorded. Ventricular dilatation was estimated by using ventricular-biparietal ratio. Patients who were in grades 1 and 2 underwent ventriculoperitoneal shunting immediately. Those in grade 3 and 4 required external ventricular drainage. Patients were maintained on an external ventricular drainage for 24-48 hours and their clinical status based on GCS recorded at regular intervals. All patients in grade 3 underwent VP shunt irrespective of their clinical improvement or change in grade after external ventricular drainage. 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 standard 18 month regimen of anti tuberculosis therapy which consisted of 3 or 4 drugs. The following factors were analyzed for their affect on final outcome, age (<12 years or > 12 years), duration from the onset of disease to detection of hydrocephalus (<3 weeks or >3 weeks), duration of altered sensorium (<72

hours or >72 hours), CSF cell count (<50 or >50mm³), CSF proteins (<50 mg% > 50 mg/dl), degree of hydrocephalus (VD ratio < 0.5% and > 0.5%), GCS (9-14 or 8-3), clinical grade assessed just before insertion of external drain or shunt surgery.

The grade at admission was the 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 of cell count, and CSF protein concentration) had no affect on long term outcome. In our series the age of the patient, duration of illness, CSF protein count and the degree of hydrocephalus had no influence on the outcome. However there was a correlation between the GCS on admission, CSF cell count and the presence of infarction on CT or MRI. This differs with the results of Mathew JM, et al. In both series age, duration of illness and CSF protein count had no influence on outcome and the GCS or grade on admission was the most important predictor of outcome. However the results of the two series differ in that in our study there was no correlation of degree of hydrocephalus with the outcome whereas in the series of Mathew JM, et al severity of hydrocephalus had an adverse impact on the out-

come. They suggested that 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. Our series of 50 patients is heterogeneous with patients of all grades have been included in the series and therefore no such recommendation can be made.

Ventriculoperitoneal shunting has been reported with tuberculosis meningitis in children as low as six months¹². In our series the youngest patient was of 3 months and 84% of the patients were in the first three decades of life.

Lamprecht D, Schoeman J, Donald P, Hartzenberg H studied 217 patients with stage 2 and 3 TBM and hydrocephalus¹³. They treated their patients with the policy of ventriculoperitoneal shunting in the acute stage if the hydrocephalus was of non communicating variety or following failed medical therapy if the hydrocephalus was communicating or communicating type. When this protocol was followed, only 65 of the 217 patients required ventriculoperitoneal shunt. Non communicating hydrocephalus was present in 38 of 65 patients and communicating in 27 patients. These 65 cases were followed for 6 months and their outcome assessed good outcome or moderate disability was seen in 55.4% and 12.3% died. The shunted patients in this study had a high complication rate of 32.3% with shunt infection and shunt obstruction each occurring in 9 out of 65 patients. The complication rate in our series is much smaller, 10%, with a mortality of 4 % compares favorably with the series of Lamprecht D, et al. This may perhaps be due to the better quality of the shunts available and improved perioperative care. Moreover in our series a large number of patients had a good Glasgow coma score and hence were of higher grade and less sick to start with.

We believe that classification of hydrocephalus with TBM into two distinct groups, obstructive (non communicating) and non obstructive (communicating) varieties is difficult as in most cases there is a combination of the two elements.

Hence a policy based solely on this criterion alone is not sufficient. However, early shunting in patients with clear cut non communicating hydrocephalus is still indicated.

Shams S, Ayesha M, Sallahuddin T, Majeed S studied 62 patients with TB meningitis which were treated with ventriculoperitoneal shunt¹⁴. The period between diagnosis of tuberculous meningitis and detection of hydrocephalus ranged from 4 days to 36 months (mean 96.5 days). The mean duration of altered sensorium was 5 days (range 1 to 21 days). Nine patients were in the pediatric age group and presented in acute stage (less than 3 weeks of symptoms) whereas 64% of the patients had a more dramatic clinical course (greater than 3 weeks before the onset of hydrocephalus). In our study 20 patients were in the pediatric age group 16 of whom had a good outcome (GOS 5 to 4) while 30 patients were in the adult age group and 23 of these had a good outcome (GOS 5 to 4). There was no significant relationship between the two parameters in our study. The stage of the disease was the most important factor affecting the outcome. Outcome in stage 2 patients was good 33.3%, moderate disability 41.6%, and in stage 3, good 9.7%, moderate disability 29.2%. In stage 4, good 0%, moderate disability 11.1%. Similar results were seen in our study where there was a positive co-relation between the Glasgow coma scale at admission and the outcome at three months post shunting. Patients with a high

Glasgow coma score (15 to 9) had a good outcome (38 out of 43) and those with a low Glasgow coma score (8 to 3) had a poor outcome (6 out of 7). This result was significant with the p value of less than 0.001. The results showed that the most important factor affecting the outcome was the stage of the disease and early diagnosis of hydrocephalus in early stage of the disease and referral for VP shunting is desired to improve the outcome.

The problem of hydrocephalus secondary to tuberculous meningitis requires a large study and analysis of many other factors which may have a

bearing on the ultimate outcome of hydrocephalus associated with TBM. Our current study is very small, consisting only of 50 patients. No major recommendation can be made with certainty in a study of this size. However the criteria we analyzed do point to the fact that the grade of the patient is an important predictor along with the presence or absence of infarction on CT or MRI scanning which reflect the degree of complicated meningitis and the pleocytosis of CSF which is believed to reflect the severity of infection.

Conclusion:

This study concludes that the good outcome of ventriculoperitoneal shunting to patients with post tuberculous meningitis was seen in 39 (78%) patients and 11 (22%) had poor outcome. The age of patient, duration of illness, CSF protein concentration and the degree of hydrocephalus have no significant relationship to the outcome of ventriculoperitoneal shunting for hydrocephalus secondary to tuberculous meningitis, whereas preoperative Glasgow coma scale, CSF cell count and CT/ MRI evidence of infarction had a significant correlation to the outcome at 3 months follow up as measured on the Glasgow Outcome Scale. However for a problem of this magnitude a large study is required for analysis of these and many other factors and we recommend that the same be conducted.

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