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Original Research Paper

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SHUNT MALFUNCTION IN TUBERCULOUS MENINGITIS- WHETHER GRADE AND CSF PICTURE AFFECT OUTCOME

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ABSTRACT

BACKGROUND: Tuberculosis remains a major global problem and a public health issue of considerable magnitude. The World Health Organisation (WHO) estimates that one third of the world's population is infected with mycobacterium tuberculosis, with the highest prevalence of tuberculosis in Asia. Shunt surgery for hydrocephalus associated with tuberculous meningitis has proven to be highly efficacious. Few studies have addressed the issue of outcome of shunt surgery and impact of CSF (Cerebrospinal fluid) picture in post tuberculous meningitis hydrocephalus shunt surgery. **MATERIAL AND METHODS** The study was a prospective study conducted in Department of Neurosurgery, PGIMER, Dr. RML Hospital, New Delhi. The duration of follow up was of 6 months. 70 patients were enrolled in the study. All patients who underwent ventriculo-peritoneal shunt surgery for hydrocephalus with tuberculous meningitis in Neurosurgery department at PGIMER & Dr.RML hospital were included in the study. All the patients who had hydrocephalus following tuberculous meningitis were evaluated using Modified Vellore grading of TBM and hydrocephalus. All the patients who underwent ventriculo-peritoneal shunt surgery had have their CSF analysis (cytology, protein, sugar, Gram stain, ZN stain, India ink and aerobic culture) done. Outcome of the surgery were evaluated based on Glasgow outcome score (GOS), radiological parameters and complications. Statistical analysis was performed by the SPSS program for Windows, version 17.0. **RESULTS** The age of patients enrolled into the study varied from 2 months to 87 years with 44.3% of patients in 1-5 years age group. Patients were divided into 4 grades according to Modified Vellore Grading. Grades at the time of admission were compared with the final Glasgow outcome scale. At the time of admission 6 patients were in Grade I, 13 patients in Grade II, 45 patients in Grade III and 6 patients in Grade IV. GOS was 5 in Grade I, 4.69 +/- in Grade II, 4.50 +/- IN Grade III and 2.17+/- in Grade IV. Outcome was compared according to Cerebrospinal fluid (CSF) cell count, sugar and protein levels but none was found to be significant. Number of shunt revisions were compared to CSF cell count and sugar level but none was found to be significant. Mean FH/ID ratio before surgery was 60.89% which was reduced to 43.70% after 6 months follow up. **CONCLUSION** Ventriculo-peritoneal shunt surgery is a safe and effective treatment modality to treat tuberculous meningitis with hydrocephalus in all grades of patients except in Grade IV. CSF protein, sugar levels and cell count neither affect the outcome nor increase the risk of shunt malfunction

KEYWORDS :

INTRODUCTION

Tuberculosis remains a major global problem and a public health issue of considerable magnitude. The World Health Organization (WHO) estimates that one third of the world's population is infected with mycobacterium tuberculosis, with the highest prevalence of tuberculosis in Asia.[1] In recent times, there has been a resurgence of tuberculosis in both developing and developed countries.[2] Tuberculous meningitis (TBM) is the most common form of central nervous system tuberculosis, the less common forms being serous meningitis, tubercular encephalopathy and spinal meningitis.[3] Hydrocephalus constitutes one of the most common complications of tuberculous meningitis. Although shunt surgery for hydrocephalus associated with tuberculous meningitis has proven to be highly efficacious, not all patients show significant improvement and many die despite intervention, suggesting that the underlying cause for the poor prognosis in these patients is multifactorial and cannot be attributed solely to hydrocephalus. So far only a few studies have addressed the issue of indications, timing, impact of outcome and other factors affecting shunt surgery in post tuberculous meningitis hydrocephalus.

MATERIALS AND METHODS

The study was a prospective study conducted in Department of Neurosurgery, PGIMER ,Dr. RML Hospital, New Delhi . The duration of follow up was of 6 months. 70 patients were enrolled in the study. All patients who underwent ventriculo-peritoneal shunt surgery for hydrocephalus with tuberculous meningitis in Neurosurgery department at PGIMER & Dr.RML hospital were included in the study. All patients received anti tuberculous therapy along with supportive treatment.[4] Patients were prescribed antiepileptic medication as and when indicated.[4] Chhabra (SurgiwearR)/ Ceredrain (HicareR) ventriculo-peritoneal shunt were used (as per availability in the hospital). All the patients who had hydrocephalus following tuberculous meningitis were evaluated using Modified Vellore grading of TBM and hydrocephalus.[5,6] All the patients who underwent ventriculo-peritoneal shunt surgery had have their CSF analysis (cytology, protein, sugar, Gram stain, ZN stain, India ink and aerobic culture) done. Outcome of the surgery were evaluated based on Glasgow outcome score (GOS), radiological parameters and complications. A prescribed proforma was filled for each patient. Patients were followed up

fortnightly for 1st month followed by monthly for next 5 months. Patients were clinically evaluated in all visits. Radiological study in the form of Computed Tomography (CT) were performed at first visit and the last (at 6 months), and also as and when the clinically indicated. Statistical analysis was performed by the SPSS program for Windows, version 17.0. Continuous variables are presented as mean ± SD, and categorical variables are presented as absolute numbers and percentage. Normally distributed continuous variables were compared using the unpaired t test, whereas the Mann-Whitney U test was used for those variables that were not normally distributed (for two groups) and ANOVA or Kruskal Wallis test was used for >2 groups. Categorical variables were analyzed using either the chi square test or Fisher's exact test. For all statistical tests, a p value less than 0.05 was taken to indicate a significant difference.

MODIFIED VELLORE GRADING OF TBM AND HYDROCEPHALUS.[5,7]

Grade	Neurological Status
Grade 1	GCS- 15 Headache, Vomiting, Fever No neurological deficit
Grade 2	GCS- 15 Neurological deficit present
Grade 3	GCS 9- 14 Neurological deficit may or may not be present
Grade 4	GCS 3-8 Neurological deficit may or may not be present

RESULTS

The age of patients enrolled into the study varied from 2 months to 87 years with 44.3% of patients in 1-5 years age group. Out of 70 patients enrolled into the study, 42 were males and 28 were females. 32 patients gave a history of contact with TB patient while 38 patients had no such history. 75.7% of patients did not have any extraneural TB while 24.3% patients had evidence of extraneural TB. 72.9% patients tested positive for Mantoux test while remaining tested negative. 58.5% patients belonged to middle socio-economic group while 41.4% patients belonged to low socio- economic group.

Outcome compared to grade at the time of admission

Grades at the time of admission were compared with the final Glasgow outcome score. There were 6 patients in grade I, and 5 of them had good recovery with GOS of 5, whereas 1 patient lost in follow up. There were 13 patients in grade II, and their mean GOS was 4.69± 0.48. 45 patients, who were admitted in grade III, had their final mean GOS was 4.50±0.76; one patient was lost to follow up and one patient died in Grade III. There were 6 patients who were admitted in grade IV, had their mean GOS of 2.17±1.84. Four patients died in Grade IV.

Outcome compared to CSF protein level

7 patients had CSF protein ≤ 50mg%, had final mean GOS 4.43 ± 0.53. 22 patients who had CSF protein ranged 51-99mg%, had final mean GOS 4.50 ± 0.91 and 39 patients who had CSF protein ≥ 100mg%, had final mean GOS of 4.28 ± 1.23. On statistical analysis p value was 0.746, suggestive of no significant difference between groups. 2 patients who were lost in follow up were excluded.

Number of shunt revisions compared to CSF protein level

When numbers of revisions were compared to CSF proteins level, it was noted that out of 7 patients in ≤ 50 mg% protein concentration in ventricular CSF at the time of surgery group, 2 patients underwent one revision, whereas 1 patient underwent three revisions. Out of 22 patients in 51-99 mg% group, 3 patients underwent one revision, and 1 patient underwent two revisions. Out of 39 patients who were admitted in ≥ 100 mg% group, 5 patients underwent one revision, 2 patients underwent two revisions, and 1 patient underwent one revision. On statistical analysis p value was 0.690; suggest no significant difference between groups.

Outcome compared with CSF sugar level

When outcome was compared with CSF sugar level at the time of surgery, it was noted that 1 patient who had CSF sugar ≤ 20mg/dl, had final GOS 5 ; 53 patients who had CSF sugar ranging from 21-49mg/dl , had final mean GOS of 4.43 ± 1.10 ; 14 patients who had CSF sugar ≥ 50 mg/dl had mean GOS of 4.07 ± 0.99. p value was 0.455, which was not statistically significant . 2 patients who lost in follow up were excluded.

Number of revisions compared to CSF sugar level

When numbers of revisions were compared to CSF sugar level, it was noted that, there was no revision in 1 patient who had CSF sugar ≤ 20mg/dl. Out of 53 patients, who had CSF sugar ranging 21-49mg/dl, seven patients were underwent one revisions, and three were underwent two revisions. Out of 14 patients, who had CSF sugar ≥ 50mg/dl , three underwent one revision, and two underwent three revisions. On statistical analysis p value was 0.062; which suggested no significant difference between groups.

Outcome compared to CSF cell count

When outcome was compared to CSF cell count, it was noted that 54 patients who had CSF cell count ≤ 50, have had mean final GOS of 4.41 ± 0.98. 11 patients who had CSF cell count ranging 51-99; have had mean GOS of 4.09 ± 1.57. 3 patients who had CSF cell count ≥ 100 had mean GOS of 4.67 ± 0.58. p value was 0.604 which was insignificant statistically. 2 patients who were lost in follow up were excluded.

Number of shunt revisions compared to CSF cell count

When numbers of revisions were compared to leukocyte count in ventricular CSF at the time of surgery, it was noted that, out of 54 patients who had count ≤ 50, 8 patients underwent one revision, 3 underwent two revisions and 2 underwent three revisions. 11 patients who had count ranging 51-99; 2 underwent one revision, whereas 3 patients who had count ≥100 did not undergo any revision. On statistical analysis p value was 0.523; suggest no significant difference between groups.

Outcome was compared according to Cerebrospinal fluid (CSF) cell count, sugar and protein levels but none was found to be significant. Number of shunt revisions were compared to CSF cell count and sugar level but none was found to be significant. Out of 70 patients, 15 patients underwent shunt revision. 10 patients underwent single shunt revision. 3 patients had undergone shunt revision twice and 2 patients had shunt revision thrice. Intestinal obstruction was recorded in 2 patients. Subdural collections were noted in 2 patients and one patient had features of over drainage. Inguinal hernia, shunt extrusion per anus and suture site infection was found in one patient each. Mean FH/ID ratio before surgery was 60.89% which was reduced to 43.70% after 6 months follow up.

TABLE 1- GRADE AT ADMISSION AND FINAL GOS

Grade at Admission	Number of Patients	Final GOS	P value				
		Mean ± SD	Number of Deaths	Overall	Grade1 vs Grade 4	Grade 2 vs Grade 4	Grade3 vs Grade 4

1	6	5.0 ± 0.0	0	<0.001	0.011	0.006	0.003
2	13	4.69 ± 0.48	0				
3	45	4.50 ± 0.76	1				
4	6	2.17 ± 1.84	4				

TABLE 2- COMPARISON WITH OTHER STUDIES

Preoperative Vellore grade/ modified Vellore grade versus poor outcome following shunt surgery (poor outcome - number of patients who died or had severe disability) [4]						
Authors (year)	Number of patients	Preoperative Vellore grade				Follow-up (months)
		I	II	III	IV	
Palur et al. (1991)	114	20	34.7	51.9	100	45.6
Singh et al. (1996)	140	0	0	39.7	65.5	No data
Mathew et al (1998)	32	No patient	No patient	21.8	91.7	23.1
Agarwal et al. (2005)	37	No patient	38	60	100	9
This study	70	0	0	2.27	66.67	6

DISCUSSION

Tuberculous meningitis is associated with a high mortality and morbidity. One of the most common complications of tuberculous meningitis is hydrocephalus, which is due to the formation of thick gelatinous basal exudates in the acute stages of the disease and adhesive leptomeningitis in the chronic stage.[8,9] Hydrocephalus is more frequent and severe in children than in adults and also occurs at an earlier stage in the disease process.[10] In the present study 40 (57.14%) patients are of less than 5 year of age and this is comparable to other studies.[11,12,13] .Kumar et al had reported increased incidence of tuberculous meningitis in middle and low socioeconomic group. In his study out of 91 patients, 80 belong to middle and lower class.[14] In our study all the patients were from middle or low socioeconomic group. In our study 32 (45.7%) patients had positive history of contact with a person diagnosed to have active tuberculosis. Out of 160 adult cases evaluated by Pehlivanoglu et al, found a positive contact history in 19% of the cases whereas, Kumar et al reported positive history of contact in 42.86% of his cases.[14,15] .Extraneural tuberculosis were found in 17 (24.3%) patients in our study, which is less as compare to study done by Pehlivanoglu et al, in which 38% cases had extraneural tuberculosis.[15] Only 3 (4.3%) patients had positive Ziehl neelsen stain in ventricular CSF in our study, which is comparable to study done by Baveja et al; in which only 2% patients showed positive stain[16]. In our study 15 (21.83%) patients underwent shunt revisions, in which 10 patients required single revision, 3 required two revisions and 2 patients required three revisions. Lamprecht et al in his study noted 16 (24.62%) patients underwent 23 revisions [17]. Palur et al, in similar study noted that 26 (22.81%) patients underwent revisions, in which 18 patients underwent single revision whereas, 5 underwent two, 2 underwent three, and 1 patient underwent more than three revisions [7]. Palur et al. for the first time laid down guidelines for shunt surgery in tuberculous meningitis hydrocephalus. They recommended that, Vellore grade I and grade II patients are ideal candidates for shunt surgery and poor grade patients (grade III and IV) should initially undergo external ventricular drainage via a ventriculostomy and only if clinical improvement occurs in the neurological status within 48 hours should they taken up for shunt placement[6]. Agarwal et al. studied 37 children with tuberculous meningitis hydrocephalus who had undergone shunt surgery. They used Vellore grading system and found that, all patients in grade IV were left with severe disability or died. They recommended shunt placement in all children of grade II and III as this policy has yielded best results. For grade IV children external ventricular drainage, followed by shunting if improvement occurs remains the most cost-effective procedure[18] . Singh et al. reported the outcome of ventriculo-peritoneal shunt surgery for tuberculous meningitis hydrocephalus in 140 children. They found a good correlation between the Vellore grades at shunt surgery with the outcome. All the mortalities occurred in patients in grade IV (49.43%) [19]. In our study, we used Modified Vellore grade of tuberculous meningitis and hydrocephalus proposed by Mathew et al[7] . External ventricular drains was placed in all grade IV patients and all of them underwent shunt surgery within 48 hours. All other patient underwent early shunt surgery. Out of 70 patients 6 were in grade I, all of them had good recovery except 1 who was lost to follow up. There were 13 patients in grade II, out of which 9 patients had good recovery and 4 of them had moderate disability. There were 45 patients admitted in grade III, out which 26 had good recovery, 16 had moderate disability, 1 had severe disability, 1 patient died and 1 was lost to follow up. Out of 6 patients admitted in grade IV, 1 had good recovery, 1 had moderate disability and 4 patients had died. Mortality in our study was 7.14%, it was 2.27% in grade III and 66.67% in grade IV which is less as compare to other studies. Palur et al in his study of 114 patients, noted that age, CSF cell count, CSF protein level, and shunt revisions did not have any significant effect in long term outcome. [6]In our study also CSF protein level, CSF sugar level and CSF cell count did not have any significant effect over outcome. We also found that CSF cell count, protein and sugar levels did not have a significant effect over revision of shunt as reported in other studies. [6] Ambekar et al[20] suggested patients with pre-operative hyponatremia and high CSF protein concentration have a higher incidence of shunt malfunction. In our study mean value of ventricular size (FH/ ID ratio) was reduced from 60.89% to 43.7% and this reduction in ventricular size was statistically significant. Bhargava et al in their study of 60 cases, reported reduction in ventricular size after shunt surgery. [21] Similar findings were also reported by Kilineoglu et al. in which 84 children who underwent shunt surgery, showed regression in the radiological findings of hydrocephalus. [22]

CONCLUSION

Ventriculo-peritoneal shunt surgery is a safe and effective treatment modality to treat tuberculous meningitis with hydrocephalus in all grades of patients except in Grade IV where an initial external ventricular drain placement to improve the general condition and grade of patient may be a better option .Good outcome following early ventriculo-peritoneal shunt surgery can be achieved in grade I, II, and grade III patients of tuberculous meningitis with hydrocephalus. CSF protein, sugar levels and cell count neither affect the outcome nor increase the risk of shunt malfunction. The benefits of ventriculo-peritoneal shunt surgery outweigh the complications associated with the procedure. The complication rate is also decreasing due to better understanding of disease, antituberculous therapy and improved shunt devices.

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