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Original Article

Analysis of Neurological Complications Associated with Bacterial Meningitis at a Tertiary Care Centre

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ABSTRACT

Background: *Bacterial meningitis is a devastating infection, with a case fatality rate of up to 30% and 50% of survivors developing neurological complications. These include short-term complications such as focal neurological deficit and subdural effusion, and long-term complications such as hearing loss, seizures, cognitive impairment and hydrocephalus. The aim of this study was to conduct a prospective multivariate analysis of statistically significant predictors for neurological complications of childhood bacterial meningitis.*

Materials and Methodology: *Present study was conducted on children aged between 1 month and 16 years who were treated for bacterial meningitis at the Department of Paediatrics, Meenakshi Medical College Hospital and Research Institute, Kanchipuram, Tamilnadu, India. 58 children reported with a confirmed bacterial aetiology. 27 patients were treated for probable bacterial meningitis.*

Results: *Of the 85 children treated for bacterial meningitis, 37 developed possible neurological complications (43.5%). The neurological complications observed were subdural effusion (25/85; 29.4%); recurrent seizures (7/85; 7.8%); hemiparesis (6/85; 6.5%); intracerebral hemorrhage (4/85; 4.7%); cerebritis (3/85; 3.9%); facial nerve palsy (3/85; 3.9%); hydrocephalus (2/85; 2.6%); and single cases of subdural hematoma, cerebral abscess, subdural empyema, and purulent ventriculitis (1.3%).*

Conclusion: *Age less than 12 months and severity of clinical presentation at admission (alteration of mental status and the occurrence of seizures) were identified as the strongest predictors for neurological complications and may be of value in selecting patients for more intensive care and treatment.*

Keywords: *Bacterial Meningitis, Neurological Complications, Hearing Loss, Hydrocephalus.*

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INTRODUCTION

The condition bacterial meningitis is considered as a devastating infection with a reported case fatality observed to be around 30%and almost 50% of the survivors develop neurological complications in the later stages of life. Bacterial meningitis is associated with high morbidity and mortality in neonates.[1,2] The major causative pathogens is considered to be related with Group -B Streptococcus and Escherichia coli, causing 65–78% of all cases, with mortality ranges varying between 13 to 25% in term-born and preterm infants.[3,4] Studies of bacterial meningitis in adults have found that approximately three-fourths of patients have developed very serious intracranial complications like hydrocephalus, subdural empyema, infarction and ventriculitis which could actually contribute to long-term neurological sequelae and resulting in mortality.[5] Therefore, few studies on the incidence and spectrum of complications and prognostic factors in young infants with bacterial meningitis are relatively few and scarce.[6] Various neurological complications reported after neonatal meningitis should be of more concerned to physicians since they can cause long term neurodevelopmental impairment and might require surgical intervention.[5] Additionally, knowledge of the factors related with poor prognosis could certainly be valuable in selecting patients for more aggressive management strategies or at least intensive monitoring, in order to optimize the functional and normal behavioural abilities in neonates, who have reported with bacterial meningitis. In adult and paediatric settings, risk factors related with certain neurological complications and sequelae have been identified like specific microorganisms, higher severity of illness and early presentation of seizure and paresis have been reported.[7] but,

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the conclusions of these studies are still conflicting and confusing in young infants and only a few population-based studies have been conducted till date.

The aim of this study was to conduct a prospective multivariate analysis of statistically significant predictors for neurological complications of childhood bacterial meningitis.

METHODS

Present study was conducted on children aged between 1 month and 16 years who were treated for bacterial meningitis at the Department of Paediatrics, Meenakshi Medical College Hospital and Research Institute, Kanchipuram, Tamilnadu, India. 58 children reported with a confirmed bacterial aetiology. 27 patients were treated for probable bacterial meningitis, based on the World Health Organization (WHO) criteria: clinical signs and symptoms of meningitis, changes in CSF and lack of an identifiable bacterial pathogen. Those children who could not able to fulfil the criteria for bacterial meningitis were certainly excluded from the study. Cases of tuberculous meningitis and neurobrucellosis, and those children younger than 1 month old were excluded from the study. The following procedure was conducted on the day of admission for every child with suspected bacterial meningitis: lumbar puncture, fluid analysis (cell count with differential, glucose, protein), gram-staining, and bacterial culture, repeated LPs after 48 hours.

In order to analyse their relationship with the incidence of neurological complications of bacterial meningitis in children treated in this ward, 16 potentially relevant predictors were chosen to be examined. p-values < 0.05 were considered statistically significant. There were no missing data on the 16 variables collected from the medical records which include 1) age (which was later categorized into specific age groups); 2) gender; 3) duration of the patients illness prior to admission, < or > 48 hours; 4) previous treatment with antibiotics; 5) presence of altered mental status at the time of presentation; 6) presence of focal neurological deficits that occurred in the period between the start of symptoms and arrival at the admission room (cranial nerve involvement or hemiparesis/quadriparesis); 7) occurrence of seizures prior to admission; 8) initial single- or dual-agent antibiotic therapy; 9) use of dexamethasone; 10) presence/absence of a primary infectious focus; 11) presence/absence of comorbidity; 12) initial turbid CSF with pleocytosis > 5,000 cells/mm3; 13) pleocytosis > 5,000 cells/mm3 after 48 hoursl 14) CSF/blood glucose ratio < 0.20; 15) increased proteinorrhachia (> 0.50 g/L); and 16) whether the infection was community or hospital-acquired.

RESULTS

85 children aged between 1 month and 16 years (58 children < 6 years; 55/85 males) were treated for bacterial meningitis. 58 children had a confirmed bacterial aetiology, as follows: 32, Neisseria meningitidis; eight, Streptococcus pneumoniae; six, Gram negative bacilli (three P. aeruginosa, two E. coli, and one K. pneumonia); five, Haemophilus influenzae type b; five, Staphylococcus aureus; and one, S. viridans. 27 patients were treated for probable bacterial meningitis, based upon the criteria followed in the study protocol. Of the 85 children treated for bacterial meningitis, 37 developed possible neurological complications (43.5%). The neurological complications observed were subdural effusion (25/85; 28.6%); recurrent seizures (7/85; 7.8%); hemiparesis (6/85; 6.5%); intracerebral hemorrhage (4/85; 4.7%); cerebritis (3/85; 3.9%); facial nerve palsy (3/85; 3.9%); hydrocephalus (2/85; 2.6%); and single cases of subdural hematoma, cerebral abscess, subdural empyema, and purulent ventriculitis (1.3%).

The incidence of neurological complications was higher in patients treated with dexamethasone, compared to those who were not less than 0.05. The mean duration of illness before dexamethasone use was three days. Almost half of the patients (35 children, 49%) were previously treated with antibiotics, but they were not associated with increased incidence of neurological complications (p > 0.05).

Table 1: Relative risk for neurologic complications by age group

Age group	N	Neurologic complications	%
0 – 1 years	32	23	71
>1 – 6 years	31	12	38
>6 – 16 years	22	2	10

Table 2: Association between various clinical factors and the development of neurological complications in children with bacterial meningitis

Prognostic factors	Good outcome (n=50)		Neurological complications (n=35)		P – value
	N	%	N	%	
Age	9	18	23	61	0.00008
Altered mental status	20	39	30	82	0.0001
Seizures	3	5	13	36	0.0004
Initial therapy with two antibiotics	13	25	27	73	0.001
Dexamethasone usage	39	77	36	97	0.02
Neurological deficit	5	9	10	27	0.037
Increased proteinorrhachia	39	77	35	94	0.047
CSF:blood glucose	12	23	13	36	0.219
Turbidity in CSF	8	16	9	24	0.41
Previous treatment with antibiotics	23	45	20	55	0.47
Community acquired infections	47	93	36	97	0.49
Duration of illness	32	64	20	58	0.61
Comorbidity	13	25	7	21	0.72
Primary focus of infections	35	70	23	67	0.74
Initial pleocytosis	30	59	23	61	0.77
Female gender	18	36	14	39	0.82

DISCUSSION

Even though there is enormous update in the field of medicine, bacterial meningitis reported for the aetiological factors for substantial morbidity and mortality in children in both developed[8,9] and in developing countries.[10,11] Sensorineural hearing loss, seizures, motor problems, hydrocephalus and mental retardation and few subtle outcomes like cognitive, academic and behavioural problems are mostly observed in post-meningitis children.[9,10] Chandran A et al in their systematic literature search, found that 49% of survivors of childhood bacterial meningitis were proposed to have one or more long-term consequence. The majority of reported sequelae were behavioural and/or intellectual disorders (45%).[14] The risk of developing long-term sequelae is greater in individuals who have acute neurological complications during the course of the disease.[6,8] Identification of predictors for early neurological complications is extremely necessary, since they are also observed to be the first predictors of long-term sequelae of childhood bacterial meningitis.

Based on the severity of clinical presentations which are manifested by the alteration of mental status and the occurrence of seizures, are basically identified as the strongest prognostic factors for neurological complications in the present study which is similar to that indicated in

numerous studies from developed[9,11] and developing countries.[5,15,16] Klinger et al observed that duration of seizures for more than 72 hours and presence of coma were the most important predictors of undesirable outcome.[17] The time required for establishing a diagnosis of bacterial meningitis dependent on the capability of primary health care services to meticulously evaluate the symptoms and to order immediate patient transfer to specialized institutions in which the prompt diagnosis can be confirmed and a suitable antimicrobial therapy can be tarter effectively. Delay in treatment which is related with a reportedly higher risk of neurological disability and death in both developed[16,17] and developing countries.[18] In the present study, duration of illness of more than 48 hours was related with increased incidence of neurological complications in survivors when compared to children with the duration of illness less than 48 hours, but the differences were not statistically significant. The mean duration of illness prior to admission was 2.2 days, which the authors consider to be an improvement of their health care system and socioeconomic conditions compared to previous reports, where the mean duration of illness in children with bacterial meningitis was 3.7 days.[9]

Children who manifested focal neurological deficit at admission had a significantly higher incidence of neurological complications. Oostenbrik et al found that children with acute focal neurological symptoms tend to have the worst prognosis.[9] The incidence of neurological complications was significantly higher in patients who were initially treated with two antibiotics (n = 35; 45%), as those children reported with severe clinical presentation at admission. The most administered antibiotic therapy for the first time was the combination of ceftriaxone with vancomycin (23%). Many clinical trials were conducted to predict the consequences of adjunctive dexamethasone on the outcome in children with bacterial meningitis.[19] The results, however, do not point unequivocally to a positive effect. In this study, adjunctive dexamethasone therapy did not minimise the incidence of neurological complications in children with bacterial meningitis. The beneficial effect of dexamethasone use could not be proved, as a result of several factors: dexamethasone was used in patients who presented with the severe clinical form of illness at admission, the mean duration of illness prior to dexamethasone use was three days, and half of children were previously treated with antibiotics.

Various other risk factors that were recognised by previous studies include mostly the alterations in various CSF parameters. Low CSF leukocyte count, low CSF glucose level, low CSF/blood glucose level, and high CSF protein level have been found as significant factors in predetermining the neurological complications of bacterial meningitis in children in both developed[8,10] and developing countries.[18] In this study, only increased CSF protein level was identified as risk factor for neurological complications. Initial turbid CSF with pleocytosis > 5,000 cells/mm3, turbid CSF after 48 hours, and CSF/blood glucose ratio < 0.20 were not identified as statistically significant factors for the development of neurological complications. An association between meningitis caused by S. pneumoniae and unfavourable evolution has been suggested in the literature.[8-11]

The primary meningeal pathogen that had been reported to be involved in causing community-acquired bacterial meningitis in children is N. meningitidis. Hib vaccination during routine childhood immunization has been supplemented since 2010, giving the ray of trust in order to minimise the burden of bacterial meningitis in children. The implementation of strategies for the empirical treatment of bacterial meningitis to reduce the mortality rate and the incidence of neurological complications is the goal of future treatments of children.[10]

CONCLUSION

To conclude that age < 12 months and the associated severity of clinical manifestation at the time of admission (alteration of mental status and the occurrence of seizures) were recognised as the strongest predictors for determining the neurological complications and may be of great asset in selecting patients for more intensive care and treatment.

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