FREQUENCY OF NEUROLOGICAL COMPLICATIONS IN CHILDREN PRESENTING WITH MENINGITIS TO A TERTIARY CARE HOSPITAL

Muhammad Sarwar,[1] Nighat Sultana,[2] Muhammad Shafqat[3]

ABSTRACT

Background and Objective: Meningitis can be defined as infection of brain covering, protecting the brain and spinal cord, resulting in inflammation. There is much gap in literature regarding frequency, complications and predictive factors in children with meningitis. The purpose of this study was to assess frequency of neurological complications in children presenting with meningitis.

Methods: This prospective longitudinal study was conducted at Pediatric Intensive Care Unit, The Children Hospital, University of child's Health Sciences from 1st Dec 2021 to 30th November 2022. Patients of both gender with meningitis were included in the study through non probability consecutive sampling. Sample size of 92 was calculated using confidence level as 95%, 8% margin of error with expected frequency of hydrocephalus as 18.8% in children with meningitis. All patients were sent to radiology department and neurological complications (Subdural effusion, Ventriculomegaly, Subdural empyema and Hydrocephalus) was recorded as per CT-scan and MRI findings and all this data was documented on pre-designed questionnaire. Data were entered and examined with SPSS version 23. Cross tabulation was done between age, gender and duration of meningitis with the complications and chi square test was applied, $p \leq 0.05$ was considered statistically significant.

Results: Male patients were 52.2% and females were 47.8%. Frequency of Post Meningitis complications were studied and results showed that seizure was observed in 57.6%, subdural effusion 42.4%, ventriculomegaly 29.3%, subdural empyema 17.4% and hydrocephalus in 10.9%. On cross tabulation, only age was found to be significantly related with subdural effusion, with a p value 0.021.

Conclusion: Neurological complications in pediatric meningitis are frequent, with seizures being most common. Age significantly correlates with subdural effusion. Timely and proper management of these neurological complications can improve the outcomes in these children.

Keywords: meningitis, infection, neurological, frequency, seizure, complications, subdural effusion

How to cite: *Sarwar M, Sultana N, Shafqat M. Frequency of neurological complications in children presenting with meningitis to a tertiary care hospital. JAIMC. 2024 ; 22(3): 95-99*

Meningitis is an infection of brain coverings called Meninges, which protects the brain and spinal card, leading to inflammation.[1] This is a very serious condition requiring rapid diagnosis and treatment.[2,3] The causative agents of bacterial meningitis vary according to age.[4,5]

1,2. Pediatric Intensive Care, The Children's Hospital & UCHS Lahore.
3. Department of Pediatrics, The Children's Hospital & UCHS Lahore.

Correspondence:
Dr Muhammad Shafqat, *Department of Pediatrics, The Children's Hospital & UCHS Lahore. muhammadshafqatsial@yahoo.com*

Submission Date: 19-07-2024
1st Revision Date: 07-08-2024
Acceptance Date: 13-09-2024

There are multiple complications that are linked to Meningitis. They can be short term such as fits and focal neurological deficits while the long-term complications include hearing loss, cognitive impairment etc.[6] Meningitis complications are more significant in low- and middle-income countries as compared with high income countries due to various factors like late availability of medical facilities and limited resources. Moreover, complications are mostly less reported in low- and middle-income countries as compared to high income countries.[6] Such complications include a range of findings such with implications for brain development, functioning and also include deficits such as hearing loss, visual loss, recurrent fits, cognitive

delay etc.[7]

A study conducted by Hsu MH et al. had shown that post meningitis frequency of fits was 58.8%, subdural effusion as 47.1%, ventriculomegaly 41.2%, subdural empyema 21.2% and hydrocephalous was of 18.8% in children.[8]

The purpose of this study was that there was no latest data available in medical literature regarding the incidence of neurological complications and its related factors in children under 15 years of age. Knowledge of post meningitis neurological complications is need of hour for more aggressive treatment options resulting in improved outcomes in children. This study was done with an aim to assess the frequency of neurological complications in children presenting with meningitis.

METHODS

This prospective study was conducted at Pediatric Intensive Care Unit, The Children Hospital, University of child's Health Sciences from 1st Dec 2021 to 30th November 2022. Sample size of 92 was calculated using confidence level as 95%, 8% margin of error with expected frequency of hydrocephalus as 18.8% in children with meningitis. Ethical permission was taken Vide IRB No:2021-476/CH-UCHS, dated 19-11-2021. Patients of either gender, age one month to 15 years, with working diagnosis of acute meningitis having complications, were included, while patients with CNS symptoms and sequelae due to a previous perinatal abuses or CNS disorder were excluded. Basic demographic information of patients (age, gender and duration of symptoms) was taken. Informed consent was taken from parents explaining the study variable and outcome before participating in this study. All patients were sent to the radiology department. Neurological complications like seizure, subdural effusion, ventriculomegaly, subdural empyema and hydrocephalus were recorded as per CT-scan and MRI findings and all this data was documented on pre-designed questionnaire. Data were entered and examined with SPSS version 23. Frequencies and percentages were calculated for qualitative variables like gender, seizure, subdural effusion, ventriculomegaly, subdural empyema and hydrocephalus. Mean ±SD was calculated for quantitative variables like age and period of meningitis. Neurological complications were stratified to age, gender and duration of meningitis. Post stratification chi square test was applied, $p \leq 0.05$ was considered statistically significant.

RESULTS

With respect to Age of patients, ranging from 1 month to 15 years with mean age of 3.47±2.70 years and mean duration of meningitis was 8.576±2.95 days. Male patients were 52.2% and females were 47.8%. Seizure was observed in 57.6%, subdural effusion 42.4%, ventriculomegaly 29.3%, subdural empyema 17.4% and hydrocephalus in 10.9% as shown in Table 1.

Table 1: *Frequency distribution of development of complications in children with meningitis during the one year follow up period (n=92)*

Complications	Frequency	Percentage
Seizures	53	57.6
Subdural effusion	39	42.4
Ventriculomegaly	27	39.3
Subdural empyema	16	17.4
Hydrocephalus	10	10.9

The results of the study showed that seizures were common in age group of 1 month to 5 years i.e. 57.7%, in male patients as compared to females i.e. 58.3% and in patients with duration of disease less than two weeks i.e. 55.4%. Subdural effusion was common in age group of 1 month to 5 years i.e. 47.4%, in male patients as compared to females i.e. 47.9% and in patients with duration of disease less than two weeks i.e. 44.6%. (Table 2) Ventriculomegaly was common in age group of 1 month to 5 years i.e. 26.9%, in female patients as compared to males i.e. 36.4% and in patients with duration of disease less than two weeks i.e. 27.7% Subdural empyema was common in age group of 6 to 15 years i.e. 21.4%, in female patients as compared to males i.e. 20.5% and in patients with duration of disease greater than two weeks i.e.

Table 2: *Relationship of age, gender and duration of meningitis with seizures and subdural effusion.*

Variables (n = 92)		Seizure		p-value	Subdural Effusion		p-Value
		Yes	No		Yes	No	
Age	0-5 years	45(57.7%)	33(42.3%)	0.969	37(47.4%)	41(52.6%)	0.021
	5-11 Years	8(57.1%)	6(42.9%)		2(14.3%)	12(85.7%)	
Gender	Male	28(58.3%)	20(41.7%)	0.883	23(47.9%)	25(52.1%)	0.263
	Female	25(56.8%)	19(43.2%)		16(36.4%)	28(63.6%)	
Duration of Meningitis (days)	1-14	46(55.4%)	37(44.6%)	0.197	37(44.6%)	46(55.4%)	0.197
	>14	7(77.8%)	2(22.2%)		2(22.2%)	7(77.8%)	

Table 3: *Relationship of age, gender and duration of meningitis with ventriculomegaly, subdural empyema and hydrocephalus*

Variables (n = 92)		Ventriculomegaly		p-value	Subdural Empyema		p-value	Hydrocephalus		p-value
		Yes	No		Yes	No		Yes	No	
Age	0-5 years	21(26.9%)	57(73.1%)	0.228	13(16.7%)	65(83.3%)	0.665	7(9%)	71(91%)	0.168
	5-11 years	6(42.9%)	8(57.1%)		3(21.4%)	11(78.6)		3(21.4%)	11(78.6)	
Gender	Male	11(22.9%)	37(77.1%)	0.157	7(14.6%)	41(85.4%)	0.458	7(14.6%)	41(85.4%)	0.232
	Female	16(36.4%)	28(63.6%)		9(20.5%)	35(79.5)		3(6.8%)	41(93.2)	
Duration of Meningitis (days)	1-14	23(27.7%)	60(72.3%)	0.295	14(16.9%)	69(83.1%)	0.687	9(10.8%)	74(89.2%)	0.980
	>14	4(44.4%)	5(55.6)		2(22.2%)	7(77.8)		1(11.1%)	8(88.9%)	

17.4%. Hydrocephalous was common in age group of 6 to 5 years i.e. 21.4%, in male patients as compared to females i.e. 16.6% and in patients with duration of disease greater than two weeks i.e. 11.1%. however, only age was found to be significantly related with subdural effusion (p=0.021) (Table 2 and 3)

DISCUSSION

Post meningitis complications are very common and can lead to poor outcomes in children. While in our study, fits was the most common complication and were noted in 57.6% patients, subdural effusion was 42.4%, ventriculomegaly 29.3%, subdural empyema was 17.4% and hydrocephalous was noted in 10.9% of cases. In another study conducted by Hsu MH et al., similar findings were observed reporting fits as most common complication following meningitis 58.8%, subdural effusion was 47.1%, ventriculomegaly 41.2%, subdural empyema 21.2% and hydrocephalous was in 18.8% of children after meningitis.[7]

A few studies have reported that the risk of post Meningitis problems was not linked directly with factors like contributing pathogens, early antibiotics or with patient's demographic status. It was also reported that early seizure can forecast poor prognosis either neurological sequelae or death after discharge.[19,20]

A nationwide community based cohort study was conducted recently, showed that occurrence of meningitis in infants was 0.38 per 1000 live births and was linked with a high mortality rate of 8%.[18] This study also showed that 29% of post meningitis cases had serious CNS complications.[19]

Moreover, in another study, the results showed a high incidence of neurological complications (up to 44.7%) in cases of post meningitis sequelae after going home. Diverse inhabitants, treatment modalities, nature of the CNCS complication, diverse age groups and changed contributing organisms may have different demonstrations of meningitis and outcome.[8-12] A review study conducted recently showed that half of post meningitis cases got focal deficits of CNS.[17]

Previous studies has shown that post meningitis CNS complications occured in 23-74% of all infants less than 3 month of age and the risk factor profile for the development of these complications varies greatly in different age group.[28,29,30]

A study conducted recently showed that temperature variability, fits, increased CSF proteins and Pneumococcal meningitis were independent factors

linked with neurological complications. It was observed that fits occuring within 3 days after onset of meningitis, are autonomous predictor of poor neurological outcome which can be elaborated by more severe and acute brain parenchymal disease leading to seizure and causing more severe brain damage.[22]

Thus, we can do risk stratification of children with early onset fits, as those needing early investigation and intervention. Past studies had also shown that higher the CSF proteins, higher will be inflammatory changes in post bacterial meningitis, leading to more sever bacterial disease.[26] So it's reasonable to consider high CSF proteins as predictor of poor prognosis later on, although this feature as not observed in our study.

Past studies showed that post meningitis subdural empyema seems to be more likely to occur in infancy due to the exceptional pathophysiology in infants.[28,29] In the current study, only nearly half of patients go through CNS intervention for empyema, and none of them received surgical evacuation. Most patients received long course of antibiotic treatment with median duration of 45 days; range: 24–73 days and only one patient died. Our results are preferring recent guideline that 3–4 weeks of antibiotics is recommended if an empyema has been drained, and better results can be attained with longer duration if the patient is conservatively managed.[30,31]

It is among the few studies in our setup about the frequency of Neurological Complications in Children Presenting with Meningitis in Pediatrics. Limitation of study is that its results cannot be generalized over large geographic area because its data is collected from one tertiary care hospital.

CONCLUSION

Post Meningitis Neurological complications and sequelae are common in infants less than one year of age after bacterial meningitis. Nearly one-half of patients with meningitis affected with fits despite early start of suitable and operative antibiotics. Thus, long-term monitoring of these cases is highly recommended, as they are at risk of CNS impairment in future.

Ethical Approval: This study was approved by Ethical Review Committee of The Children's Hospital, Lahore, vide No. 2021-476/CH-UCHS Dated 19-11-2021

Conflict of Interest: *None*

Funding Source: *None*

AUTHOR'S CONTRIBUTION

Conceptualization and study design	MS, NS
Data Acquisition	MS, MSh
Data Analysis/ interpretation	MS, NS, MSh
Manuscript drafting	MS, NS, MSh
Manuscript review	MS, NS, MSh

All authors read and approved the final draft.

REFERENCES

1. Ramgopal S, Walker LW, Vitale MA, Nowalk AJ. Factors associated with serious bacterial infections in infants ≤60 days with hypothermia in the Med.2019;37(6):1139-43.
2. Lien CY, Lee JJ, Tsai WC, Chen SY, Huang CR, Chien CC, et al. The clinical characteristics of spontaneous gram-negative bacterial meningitis in adults: a hospitalbased study. J ClinNeurosci. 2019;64:101-5.
3. Fuentes-Antrás J, Ramírez-Torres M, Osorio-Martínez E, Lorente M, Lorenzo-Almorós A, Lorenzo O, et al. Acute community acquired bacterial meningitis: update on clinical presentation and prognostic factors. New Microbiol. 2019;41(4):81-7.
4. Chacon-Cruz E, Roberts C, Rivas-Landeros RM, Lopatynsky-Reyes EZ, Almada-Salazar LA, Alvelais-Palacios JA. Pediatric meningitis due to Neisseria meningitidis, Streptococcus pneumoniae and Group B Streptococcus in Tijuana, Mexico: active/prospective surveillance, 2005-2018. Ther Adv Infect Dis. 2019 Mar 11;6:2049936119832274. doi: 10.1177/2049936119832274. PMID: 30886712; PMCID: PMC6413420.
5. Linder KA, Malani PN. Meningococcal meningitis. JAMA.2019;321(10):1014.
6. Zainel A, Mitchell H, Sadarangani M. Bacterial meningitis in children: neurological complications, associated risk factors, and prevention. Microorganisms. 2021; 9(3):535.
7. Hsu MH, Hsu JF, Kuo HC. Neurological complications in young infants with acute bacterial meningitis. Front Neurol. 2018;9:903
8. Svendsen MB, Ring Kofoed I, Nielsen H, Schønheyder HC, Bodilsen J. Neurological sequelae remain frequent after bacterial meningitis in children. Acta Paediatr. 2020 Feb;109(2):361-367.

9. Sonko AM, Dube FS, Okoi CB, Diop A, Thiongane A, Senghore M et al. Changes in the Molecular Epidemiology of Pediatric Bacterial Meningitis in Senegal after Pneumococcal Conjugate Vaccine Introduction. Clin. Infect. Dis. 2019;69(S):156–163.
10. McAlpine A,Sadarangani M. Meningitis vaccines in children. Curr. Opin. Infect. Dis. 2019; 32: 510–516.
11. Mwenda JM, Soda E, Weldegebriel G, Katsande R, Biey JNM, Traore T, et al. Pediatric Bacterial Meningitis Surveillance in the World Health Organization African Region Using the Invasive Bacterial Vaccine-Preventable Disease Surveillance Network, 2011–2016. Clin. Infect. Dis. 2019; 69: 49–57.
12. Kostenniemi UJ, Bazan A, Karlsson L, Silfverdal SA. Psychiatric Disabilities and Other Long-term Consequences of Childhood Bacterial Meningitis. Pediatr. Infect. Dis. J. 2020; 40: 26–31.
13. Teixeira DC, Diniz LMO, Guimarães NS, Moreira HMD, Teixeira CC, Romanelli RM. Risk factors associated with the outcomes of pediatric bacterial meningitis: A systematic review. J. Pediatr. 2020, 96, 159–167.
14. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. Haemophilus influenzae type b (Hib) vaccine: what you need to know. Hib vaccine. 2021 Aug 6. Available from: https://www.cdc.gov/vaccines-/hcp/current-vis/hib.html citeturn0search1
15. Ngocho J.S, Magoma B, Olomi G.A, Mahande M.J, Msuya S.E, De Jonge M.I, et al. Effectiveness of pneumococcal conjugate vaccines against invasive pneumococcal disease among children under five years of age in Africa: A systematic review. PLoS ONE 2019;14:e0212295.
16. Centers for Disease Control and Prevention. Meningitis: resources for healthcare professionals. 2019. Available from: https://www.cdc.gov-/meningitis/index.html citeturn0search0
17. Koelman DLH, van Kassel MN, Bijlsma MW, Brouwer MC, van de Beek D, van der Ende A. Changing epidemiology of bacterial meningitis since introduction of conjugate vaccines: 3 decades of national meningitis surveillance in The Netherlands. Clin Infect Dis 2021; 73:e1099-107
18. Zasowski EJ, Bassetti M, Blasi F. A systematic review of the effect of delayed appropriate antibiotic treatment on the outcomes of patients with severe bacterial infections. Chest 2020;158:929-38.
19. National Institute for Health and Care Excellence. Fever in under 5s: assessment and initial management. 2019 Nov 7 [updated 2021 Nov 26; cited 2025 Mar 3]. Available from: https://www.nice.org.uk/guidance/ng143
20. Chenou F, Azevedo J, Leal HF, Gonçalves MS, Reis JN. Bacterial meningitis in patients with sickle cell anemia in Salvador, Bahia, Brazil: a report on ten cases. Hematol Transfus Cell Ther2020;42:139-44.
21. World Health Organization. Defeating meningitis by 2030: a global roadmap. 2021. Available from: https://www.who.int/initiatives/defeating-meningitis-by-2030
22. Centers for Disease Control and Prevention. Guideline for isolation precautions: preventing transmission of infectious agents in healthcare settings. 2019. Available from: https://www.cdc.gov/infection-control/guidelines/isolation/index.html
23. Public Health England. Meningococcal disease: guidance for public health management. 2019. Available from: https://www.gov.uk/government/publications/meningococcal-disease-guidance-on-public-health-management
24. Public Health England. Listeriosis in England and Wales: summary for 2019-2021.
25. National Institute for Health and Care Excellence. Tuberculosis.2019.
26. Zainel A, Mitchell H, Sadarangani M.Bacterial meningitis in children: neurological complications, associated risk factors, and prevention. Microorganisms. 2021;9:535.
27. Teixeira DC, Diniz LMO, Guimarães NS, Moreira HMAS, Teixeira CC, Romanelli RMC. Risk factors associated with the outcomes of pediatric bacterial meningitis: a systematic review. J Pediatr (Rio J) 2020;96:159-67.
28. Urooj S, Saleem M, Khurshid A. Acute bacterial meningitis in children with 1st episode of febrile seizures. Professional Med J 2021; 28(1):42-46.
29. Kumar N, Midha T, Rao YK. Risk factors of recurrence of febrile seizures in children in a tertiary care hospital in Kanpur: A one year follow up study. Ann Indian Acad Neurol. 2019; 22(1):31-6
30. Leung AK, Hon KL, Leung TN. Febrile seizures: An overview. Drugs Context. 2018;7:212536
31. Ellul MA, Benjamin L, Singh B, Lant S, Michael BD, Easton A et al. Neurological associations of COVID-19. Lancet Neurol. 2020 Sep;19(9):767-783. doi: 10.1016/S1474-4422(20)30221-0. Epub 2020 Jul 2. PMID: 32622375; PMCID: PMC7332267.