

PREVALENCE AND RISK FACTORS OF HEMOPHILUS INFLUENZA TYPE B MENINGITIS: ROLE OF VACCINATION AND SOCIAL DEMOGRAPHY IN THE PATHOGENESIS

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Abstract: Bacterial meningitis is a condition caused by a bacterial infection in the meninges that results in inflammation. The causative agent varies according to age and other related factors. Hemophilus Influenza type B (Hib) is the most common cause of meningitis in children. This study aimed to determine the prevalence of H. influenza meningitis, the role of vaccination, and demographic factors in the etiology of Hib meningitis. Using a cross-sectional design, the study was conducted at the Pediatrics department of Ayub Teaching Hospital, Abbottabad, for six months, from 19-9-2023 to 19-3-2024. After obtaining ethical approval from the IRB of Ayub Teaching Hospital Abbottabad, a cross-sectional study was conducted, and 143 patients who met the inclusion criteria were included in the study. Hib vaccination status was confirmed by history and the presence of a vaccination card. Cerebrospinal fluid (CSF) was collected and sent for analysis, including microscopy and culture. The mean age of the patients was 44.92±51.48 months, with a male-to-female ratio of 1.38:1. Seventy (49.65%) patients were fully vaccinated against the Hib virus. The study results showed that H. influenza growth on CSF culture was noted in 14 (9.79%) patients. The Hib positive status of these cases was significantly associated with gender, residential area, and socioeconomic class of the patient at p values of 0.005, 0.047, and 0.041. In conclusion, despite the use of conjugate vaccine, Hib remains a cause of meningitis, and the pathogenesis of Hib meningitis is associated with gender, residential category, and socioeconomic class of the patient.

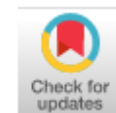
Keywords: Cerebrospinal Fluid, Hemophilus influenza type b, Bacterial Meningitis

Introduction

Meningitis is one of the essential causes of childhood febrile illness. Despite advances in diagnosis, treatment, and vaccine development, meningitis remains a devastating problem in the children age group (Jawaid et al., 2016). Bacterial meningitis is an infection of the membranes (meninges) and CSF surrounding the brain and spinal cord. It is a significant cause of death and disability worldwide esp., the developing and underdeveloped nations (Almeida et al., 2017; Shrestha et al., 2015). Hemophilus influenza type b (Hib), Neisseria meningitidis (meningococcus), and Streptococcus pneumonia (pneumococcus) are the three primary pathogens found to cause bacterial meningitis (Almeida et al., 2017). In addition to the top three, a variety of other bacteria may also result in bacterial meningitis. In many poor nations, group B streptococci, also known as Streptococcus agalactiae, is the leading cause of newborn bacterial meningitis in preterm and term babies up to three months of age (Houry et al., 2017). A gram-negative coccobacillus that can be encapsulated or not is H influenza. Six serotypes are distinguished based on the composition of the capsule polysaccharide (a-f) (Almeida et al., 2017). The most virulent and common cause of bacterial meningitis is serotype B (Almeida et al., 2017). Regardless of the underlying reason, the majority of patients present with similar clinical symptoms. Typical symptoms include headache, nausea, vomiting, restlessness, altered awareness, and irritability (Petra et al., 2015). In children older than 18 months, a positive Kerning and Brudzinski sign, fever, and neck stiffness are common slugging fontanelles are other found abusive to neonates (Petra et al., 2015). The diagnosis

of bacterial meningitis is supported by the combination of typical clinical signs subsequent laboratory tests that demonstrate the inflammatory response in CSF, and Gram's stain on culture and sensitivity. Hib is shown to be the causative agent. A specific serotype may be identified using polymerase chain reaction (Almeida et al., 2017). Six Up until the 1990s, Hib was the cause of three million invasive infections globally, which led to 386,000 pediatric deaths annually (Almeida et al., 2017). The incidence and mortality of invasive Hib illness in all age groups fell sharply from 4/100,000 in 1987 to 0.11/100,000 in 2007 after the introduction of the Hib vaccination (Almeida et al., 2017). Since 2008, Pakistan has also seen this trend, with the establishment of a standard vaccination regimen at 6, 10, and 14 weeks of age as well as at 18 months (Khowaja et al., 2013). In a 2013 research done in Nepal on children under the age of five, out of 252 suspected instances, 7.2% of the cases were bacterial meningitis, as determined by Gram staining and culture, with H. influenza accounting for 38.9% of the cases (Shrestha et al., 2015). Considering the Hib meningitis' prevalence, importance of vaccination and the current status of routine immunization in Pakistan, the study is undertaken to study the prevalence of H. influenza infection in pediatric cases of bacterial meningitis and look into role of vaccination and sociodemographic variables in the pathogenesis of the disease. Results will add to the existing body of knowledge and would be helpful for practitioners and policymakers to devise meaningful interventions at clinical and community level.

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Methodology

The pediatrics department of Ayub Teaching Hospital, Abbottabad, conducted a cross-sectional study from 19-9-2023 to 19-3-2024 with IRB approval. The following assumptions were used to calculate 143 samples for health research using WHO tools: Confidence interval: 95%. Estimated 38.9% 3 100% accuracy = 8%. A non-probability sequential sample technique includes all children under 14 with bacterial meningitis, regardless of gender. All patients with headache, fever, stiff neck, pleocytosis (an increased cell count, mainly of leukocytes) on CSF microscopy, and bacterial growth on CSF culture were included in the study. Bacterial meningitis is linked with increased polymorph nuclear leukocyte numbers, protein concentrations above 100 mg/dl, and CSF sugar below two-thirds of blood sugar. Classically symptomatic children with negative CSF values were excluded. The same happened for patients whose guardians refused study participation. The authors used a pro forma to collect all data. Patient guardians granted written informed consent. Privacy implications were ensured. History and vaccination card validated Hib vaccine status. CSF was aseptically extracted and sent to the pathology department for microscopy and culture by a CPSP pathologist fellow—Gram staining for gram-negative coccobacillus and a positive CSF culture of Hib after 48 hours identified Hib meningitis. The patient's family's monthly income determined low, medium, and high socioeconomic status. Poor people earned less than 50,000 Pakistani Rupees (PKR), middle-class people earned between 50,000 and PKR 1,000,000, and high-socioeconomic families earned more than PKR 1,000,000. See Figure 1. They have a look at hiring a non-possibility sequential pattern approach, such as 143 pediatric sufferers beneath 14 with bacterial meningitis signs. Data collection involved seasoned forma for systematic data accumulating, with a focal point on validating Hemophilus Influenza type B vaccination repute and conducting cerebrospinal fluid evaluation, consisting of microscopy and subculture, to identify Hib's presence. SPSS 23 was used for the data analysis. The data were characterized using measures of proportions and central tendencies. H. influenza meningitis was stratified for inferential analysis based on age, gender, and vaccination

status to detect effect modification. A p-value of less than 0.05 was considered significant when using the post-stratification chi-square test. All of the results were presented using tables and diagrams.

Results

The study included 143 patients. Patients ranged in age from 1 to 144 months, with a mean of 44.92±51.48 months. Among 144 patients, 83 (58.04%) were male and 60 (41.96%) females. Patients were 1.38:1 male-female. Results indicate a mean patient weight of 11.76±8.88 Kg, with lowest and highest weights of 2 and 40 kg, respectively. 70 (49.65%) of 143 patients were wholly vaccinated, 52 (36.88%) were partly vaccinated, and 19 (13.48%) were unvaccinated. CSF examination revealed a mean white blood cell count of 1035.73±1616.63, with lowest and highest levels of 1.17 and 9000. 87.80% of patients had high polymorphs, 12.2% had raised lymphocytes, and the mean red blood cell count was 234.14±421.66. The mean CSF protein level was 179.55±72.460, with lowest and highest levels of 3 and 493. Patients had a mean sugar level of 87.60±44.38, with lowest and highest readings of 0.1 and 194, respectively. Hemophilus CSF culture growth was found in 14 (9.79%) individuals. The investigation demonstrated that H. influenza was discovered in 8 (8%) patients aged five years or less (≤60 months) and 6 (14%) patients aged >60 months, with a statistically insignificant difference. 0.357 p-value. H. influenza was detected in 13 (15.7%) male and 1 (1.7%) female patients. This difference was significant (p=0.005). Significant associations were discovered between Hib meningitis and sample residential and socioeconomic distribution. A statistically significant majority of 10 of 14 Hib meningitis cases were urban (p=0.047). Over half of Hib meningitis cases were from low socioeconomic groups, and the connection was significant at p=0.041. The research found that H. influenza caused meningitis in 4 (5.7%) wholly vaccinated patients, 5 (9.6%) partially vaccinated patients, and 3 (15.8%) non-vaccinated patients. A statistically insignificant difference. Thus, p=0.156. (Table 1, figure 2)

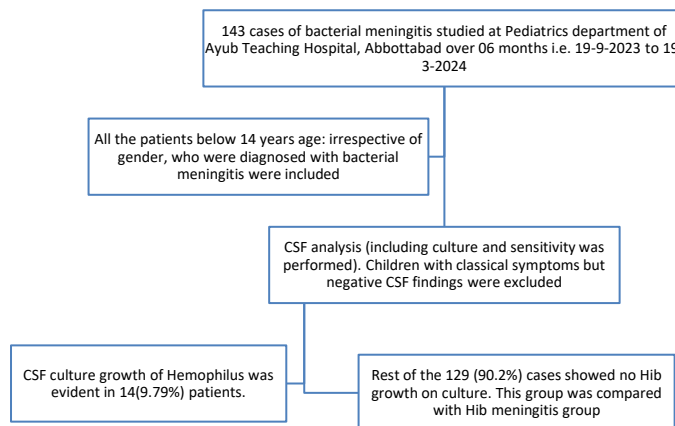


Figure 1: Study methodology flow chart

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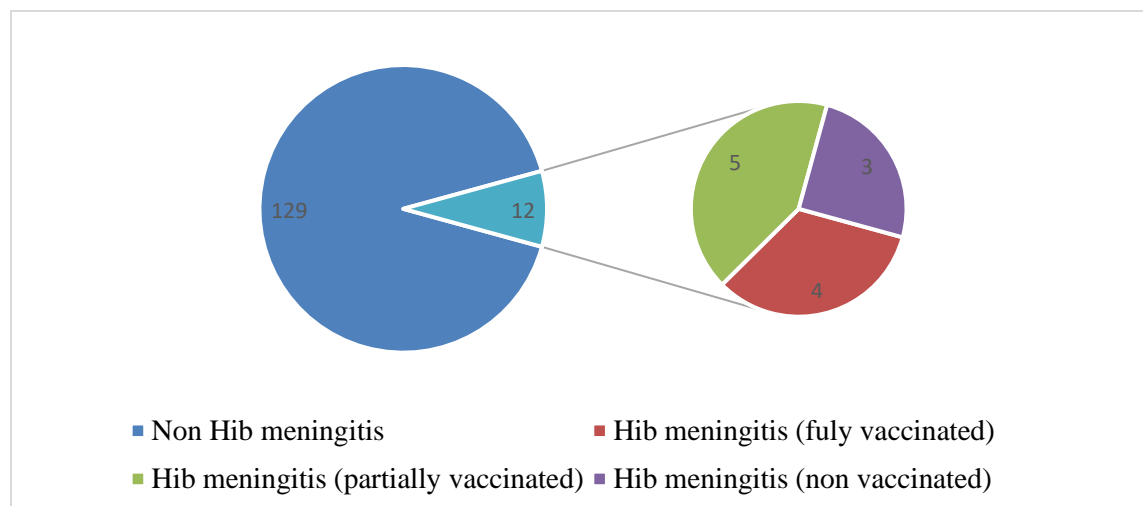


Figure 2: shows the distribution of meningitis cases per infective agent and hib vaccination status.

Table 1: Comparison of the categorical variable concerning H influenza meningitis

Variable	H. influenza cultured		p-value
	Yes	No	
Age (<5yrs/>5yrs)	8/6	92/37	0.357
Gender (male/female)	13/1	70/59	0.005
Residential area (rural/urban)	4/10	59/70	0.047
Socioeconomic status (high/middle/low)	1/4/7	18/50/61	0.041
Hib vaccination status (complete/partial/none)	4/5/3	66/47/16	0.156

Discussion

Hemophilus influenza type b, or Hib, is thought to be the most frequent cause of invasive infections in young infants globally, except in nations where the Hib conjugate immunization is regularly administered (Adegbola et al., 1999; Batuwanthudawe et al., 2010). The patients in this research were 44.92±51.48 months old on average. Among the 144 patients, 83 (58.04%) were men and 60 (41.96%) were women. The patients' male-to-female ratio was 1.38:1. Previously published research suggests that affectees of Hib meningitis were mainly males (67.5% versus 12.5% for females). Most cases belonged to the middle age group (mean = 38.3) (Khater and Elabd, 2016). Fouad et al (Fouad et al., 2014). Males were more likely than females to have bacterial meningitis (61% vs. 39%), while the illness was spread across all age categories with low incidence in newborns and those over 60. Zeinab Berangi et al (Berangi et al., 2019). found 58.51 male cases and 33.51 female cases. The gender distribution revealed that males had more bacterial meningitis than women. This research found Hemophilus CSF culture growth in 14 (9.79%) patients. Previously published data also showed Hib meningitis frequency. Zeinab Berangi et al (Berangi et al., 2019). found that streptococcus pneumonia, Hemophilus influenza, and Neisseria meningitides caused the most bacterial meningitis cases: 266 (23.44%), 145 (12.78%), and 95 (8.37%). Before H. influenzae type b conjugate vaccines were available in the US, 45–48% of bacterial meningitis cases were caused by it (Schlech et al., 1985; Wenger et al., 1990). Now, only

7% are caused by it (Schuchat et al., 1997; Thigpen et al., 2011)..S Infant mortality and meningococcal infections were more significant, but streptococcus pneumoniae complications were higher, according to Marji (Marji, 2007). CSF culture and Latex agglutination were positive in 11 and 39 instances, respectively—a 2013 Nepalese investigation of 252 probable cases among children under 5. Out of them, 7.2% developed bacterial meningitis. Further Gram staining and culture-confirmed H. influenza (38.9%) as the significant meningitis pathogen (Shrestha et al., 2015). The Lombok Island vaccination study (Gessner et al., 2005) in Indonesia found seven instances of Hib meningitis per 100,000 children aged <5 years. The 2000 Thai Ministry of Health Hib research, employing LAT and a population-based prospective approach, revealed 3.64 Hib meningitis cases per 100,000 in the <5-year age group, comparable to the current study. Hospital data indicates an incidence rate of 8.9 cases per 100,000 among Indians aged <5 years (Steinhoff, 1998). Our research demonstrated a substantial connection between Hib meningitis, sample residence, and socioeconomic status. A statistically significant majority of 10 of 14 Hib meningitis cases were urban (p=0.047). Over half of Hib meningitis cases were from low socioeconomic groups, and the connection was significant at p=0.041. This more extraordinary occurrence in poor socioeconomic urban households is likely because Hib meningitis is an infectious disease, and its transmission rate is increased in crowded locations and without sufficient cleanliness. Another important discovery was that patient

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vaccination status did not affect Hib culture growth. Hib immunization has reduced Hib meningitis, according to earlier research. Even while no direct association between vaccination status and Hib meningitis was found, herd immunity may cause the fall in incidence. Antibiotics before CSF sampling might suppress the organism and cause false negative cultures, casting doubt on CSF culture's accuracy in diagnosing Hib meningitis. Wang et al (Wang et al., 2014). also identified bacterial meningitis in five cases (9%) by CSF cultures and 25 (45%) by real-time PCR. They considered real-time PCR much more sensitive than culture for diagnosing bacterial meningitis, particularly in their study, where 68% of patients had received prior antimicrobial treatment. Their CSF samples yielded negative culture results by Wu et al (Wu et al., 2013). and Sacchi et al. I have reached a similar conclusion (Sacchi et al., 2011), who stated that real-time PCR increases diagnostic yield for bacterial meningitis and is ideal for routine surveillance in developing countries. According to Brouwer et al (Brouwer et al., 2010). CSF cultures are documented to be positive only in 1/10th of the previously antibiotic-treated patients in developing countries. A similar result was found by Afifi et al (Afifi et al., 2007), who reported low rates of culture-positive CSF samples (8%) in suspected cases of bacterial meningitis.

Conclusion

According to the study's findings, Hemophilus influenza type B, often detected by CSF culture, is a prevalent cause of bacterial meningitis. Patients from lower socioeconomic classes in metropolitan areas were more likely to have this infection. However, the diagnosis of Hib meningitis was not substantially correlated with the vaccination status.

Declarations

Data Availability statement

All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate.

Approved by the department Concerned.

Consent for publication

Approved

Funding

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Conflict of interest

The authors declared an absence of conflict of interest.

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