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Research Article

Clinical Outcome and Its Associated Factors among Children with meningitis Admitted in Debre Markos Comprehensive Specialized Hospital, Northwest Ethiopia, 2019

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Abstract

Background: Meningitis remains a major cause of mortality and morbidity in patients in many countries of the world including Ethiopia. This study aimed to assess clinical outcomes and associated factors with meningitis outcome among children who were admitted to Debre Markos Comprehensive Specialized Hospital from January 1, 2017 to December 30, 2018.

Methods: A retrospective cross-sectional study was conducted. The study includes All pediatric meningitis 211 cases from the age of one month to fourteen who were admitted due to meningitis in Debre Markos Comprehensive Specialized Hospital. Data were entered, cleaned, and analyzed using SPSS for Windows, version 20. A backward stepwise multivariable logistic regression was applied with 95% confidence interval of odds ratio (OR) and statistical significance less than 0.05 p-value were taken as cut off value.

Results: The study showed that 18.9% of children with meningitis developed bad outcomes. In this study, children who were a worse clinical condition at admission 6 times more likely to develop bad outcomes [AOR= 6.321(2.121, 18.837)] and having a seizure at admission almost 19 times more likely to develop bad outcomes [AOR=18.953(6.677, 53.799)].

Conclusions: About one in five children with meningitis developed bad outcomes. The health care team should due attention to improving care for patients with severe conditions at admission and with seizures management to control those factors for poor outcomes in children.

Keyword: Bad outcomes, Meningitis, Risk, Children

Abbreviations: AFB --Acid-Fast Bacilli; AOR--Adjusted Odds Ratio; CSF --Cerebro-Spinal Fluid; CNS--Central Nervous System; DMRH—Debre Markos Referral Hospital; Hib-- Haemophilus influenzae type b; WBC--White Blood cells.

Background

Meningitis, termed arachnoiditis or leptomeningitis, is an inflammation of the membranes that surround the brain and spinal cord, thereby involving the arachnoids, pia mater, and interposed cerebrospinal fluid (CSF). The inflammatory process extends throughout the subarachnoid space around the brain, spinal cord, and ventricles. It is classified into septic meningitis and aseptic meningitis as shown below [1].

Bacterial or septic meningitis is an acute meningeal inflammation secondary to a bacterial infection that generally evokes a polymorph nuclear response in the CSF. Bacterial meningitis is characterized by severe headache, fever, intolerance to light and sound, and rigidity of muscles, especially those of the neck. The central nervous system (CNS) inflammatory reaction from bacterial meningitis may result in decreased consciousness, seizures, raised intracranial pressure, and stroke [2]

Aseptic meningitis refers to a meningeal inflammation without evidence of pyogenic bacterial infection, usually accompanied by mononuclear pleocytosis. Aseptic meningitis is subdivided into two categories: nonbacterial meningeal infections (typically viral or fungal meningitis), and noninfectious meningeal inflammation from systemic diseases (such as sarcoidosis), neoplastic disease (leptomeningeal carcinomatosis or neoplastic meningitis), or drugs [3].

Globally, the most common bacteria responsible for meningitis are Streptococcus pneumoniae, Neisseria meningitides (N. meningitidis), and Listeria monocytogenes and Haemophilus influenzae. In children, meningococcal, Haemophilus influenzae type b (Hib), and Streptococcus pneumoniae

are the most common causes for pediatric meningitis[4].

A region extending from Ethiopia in the east to the Gambia in the west and including 15 Sub Saharan Africa countries is considered as "**meningitis belt**". It is named because of its high prevalence of endemic meningitis with periodic occurrence due to N.meningitidis [5, 6]. Until recently where, meningitis was a greatly feared infectious disease because it struck and killed many of its victims among children with mortality rates of up to 30%. Moreover, 20–50 % of pediatric patients who survive the infection have serious and permanent neurological sequelae, which include deafness, mental retardation, and learning impairment, sensory-motor deficits, seizure disorders, and cerebral palsy. The incidence of neurologic sequelae of bacterial meningitis in children has not significantly improved over the last decade. Hearing impairment is the most common neurological sequel following meningitis [1, 7].

The incidence of meningitis has dramatically decreased Beyond the neonatal period, since the routine use of Hib, conjugate pneumococcal, and conjugate meningococcal vaccines in the United States, [8, 9].

Management of meningitis caused by bacteria is a medical emergency. The therapeutic goal is to initiate antibiotic therapy within 60 minutes of patient arrival in the emergency room. In patients suspected of having bacterial meningitis, CSF should be obtained for cultures and empirically antimicrobial therapy should be initiated without delay [10, 11].

Although antibiotics are often administered without laboratory results of CSF culture and sensitivity which may affects clinical outcome, however, there is limited information available on the risk factors and clinical outcomes of meningitis. Therefore, this study aimed to identify factors associated with clinical outcomes of meningitis among children admitted in Debre Markos Comprehensive Specialized Hospital, Northwest Ethiopia.

Objectives

To determine clinical outcomes and associated factors among pediatric meningitis patients who were admitted in Debre Markos Comprehensive Specialized Hospital due to meningitis from January 1, 2017 to December 30, 2018 in Debre Markos, North West Ethiopia.

Methods

Study area and period; The study was conducted in Debre Markos Comprehensive Specialized Hospital, which is located in Debre Markos town, Northwestern Ethiopia. The hospital is located 299 km far from Addis Ababa, the capital city of Ethiopia and an additional 265 km long to get Bahir Dar city of Amhara Regional state. Data collection was conducted from March 8, 2019, to April 6, 2019 G.C

Study Design

A retrospective cross-sectional study was conducted.

Population

Source population: All pediatric meningitis cases who were admitted to Debre Markos Comprehensive Specialized Hospital from January 1, 2017 to December 30, 2018.

Study population

All pediatric meningitis cases from the age of one month to fourteen who were admitted due to meningitis in Debre Markos Comprehensive Specialized Hospital from January 1, 2017 to December 30, 2018.

Inclusion and Exclusion criteria

Inclusion criteria

All pediatric meningitis cases from the age of one month to fourteen years who were admitted to Debre Markos Referral Hospital from January 1, 2017 to December 30, 2018.

Exclusion criteria

Children admitted with a diagnosis of meningitis with incomplete medical records weren't included. The initial diagnosis of meningitis changed to others like urinary tract infection malaria and pneumonia, were not included.

Sampling size determination and sampling techniques

Sample size determination: The sample size (n) of this study was determined based on a single population proportion (p) formula by considering a 5% margin of error, 15% prevalence, and 95% confidence interval. The total sample size was 196.

Sampling procedures /Techniques/

Systematic sampling was used to assess the outcomes and associated risk factors of pediatric meningitis. All 211 pediatric meningitis patients aged from one month to fourteen years who were admitted in the study period will be taken, and 15 cases were excluded based on the criteria.

Data collection tool

Data were collected from the patient files and recordings using checklists.

Data collection procedure

Data were collected from the secondary data which was obtained from patient files and registration books in DMRH March 8/2019-April 6/2019 G.C. Data were collected by 2 health professionals who had degree holders and one supervisor who observed the data collection process.

Data quality control

The record was checked for its completeness using a checklist. The training was given to the data collectors and the supervisor for 1 day.

Study variable

Dependent variables: Clinical outcomes (Good versus Bad)

Independent variables

- Age
- Residence
- Sex
- Season
- accination

Operational definition

Good outcome: Good outcome means improvement without acute complications. Signs and symptoms of suspected meningitis like fever (temperature ≥38°C) and at least one of the following meningeal signs: convulsions, bulging fontanels in children or stiff neck, poor sucking or irritability, prostration

or lethargy, or petechial rash returned to normal (improved) condition after initiation of therapy

Bad outcome: Poor outcome comprises as death within the ward, developed acute neurologic complications: septic shock, impaired mental status, brain abscess, seizures, hydrocephalus, focal deficits (hearing loss, cranial nerve palsies, hemiparesis, or quadriparesis during treatment or at discharge, refer to a higher-level care and left against medical advises with no improvement after initiation of treatment.

Pediatrics: Age less than or equal to fourteen years.

Data analysis: Data were entered, cleaned, and analyzed using SPSS for Windows, version 20. To ensure the quality of data entry, it entered into two computers. Frequencies and cross-tabulations were used to summarize the data. Bivariate analysis was done for all independent variables. Associated variables with statistical significance of p-value less than 0.25 in the bivariate analysis were entered in the final multivariable logistic regression model. A backward stepwise multivariable logistic regression was applied. Lastly, an odds ratio (OR)was presented with a 95% confidence interval and the level of statistical significance was presented based on a p-value less than 0.05.

Results

Socio-demographic characterization: One hundred ninety-six pediatric files were reviewed. Of the total, 125(63.8%) were males and 71 (36.2%) were females. Overall, 101 (51.5%) were between one month and one-year-old and 95 (48.5%) were between one and fourteen years, as shown in Table 1.

Table 1: Socio-demographic characteristics of meningitis patients who were admitted in DMRH from January 1, 2017 to December 30, 2018

Variables		Frequency	Valid Percent
Sex	Male Female	125 71	63.8 36.2
Age	1 month-1 year 1-2 years 3-5 years 6-14 years	102 22 33 39	52.0 11.2 16.8 19.9
Residence	Urban Rural	85 111	43.4 56.6

Possible risk factors for meningitis

From the selected factors, 83(45.4%) completed their immunization. Among pediatric meningitis cases, 124(79%) were recorded as no sign of a nutritional problem and 72(36.7%) of them took corticosteroid drugs before the initiation of antibiotics. In most patients, 72(36.7%) were admitted in the spring season, as shown in Table 2.

Table 2: Possible risk factors for meningitis patients who were admitted in DMRH from January 1,2017 to December 2018

Variables		Frequency	%
Season	Winter Autumn Summer Spring	30 44 50 72	15.3 22.4 25.5 36.7
Co-infection*	Yes No	1 195	.5 99.5
Immunization status (n=183)	Incomplete Complete Not started up-to-date	4 83 48 48	2.2 45. 4 26.2 26.2
Use of corticosteroid	No Yes	112 72	63.3 36.7
Nutritional status(n=157)	Malnourished No sign of malnutrition	33 124	21 79

*Co-infection with AIDS

Clinical conditions and physical findings

Regarding clinical presentation at admission, 61(31.1%) were a worse condition, 164(83.4%) cases had vomiting, 57(29.1%) cases had seizures, and most of them170(86.7%) presented with a complaint of fever.

Regarding physical findings, 84 (42.9) of them had respiratory distress, 57(28.1%) had seizure, and 25(12.8) were unconscious. Most patients who had a fever, 127(64.8 %) were febrile with a body temperature greater than or equal to 38 0C. In all patients, 75(38.7%) and 71(28.2%) were positive for neck stiffness and Brudzinski's & kerning's sign, respectively. Among the total cases of the study, 6(3.1%), 10(5.1%), and 3(1.5%) had bulged fontanel, nerve palsies, and paralysis, respectively.

Investigations

From one hundred ninety-six patients, cerebrospinal fluid (CSF) analysis was done for all participant; among them, 84(62.2%) had confirmed meningitis. A gram stain was done for 77(57%), and acid-fast bacilli (AFB) test was done for 55 patients there were no positive findings. From the total participants, 2 (1%) cases were developed hydrocephalus, as shown in Table 3.

Table 3: Investigation of pediatric patients who were admitted in DMRH due to meningitis from January1, 2017 to December 30, 2018

Variables		Frequency	%
WBC in CSF (n=135)	> 20 cells/ mm^3 < 20 cells/ mm^3	84 112	42.9 57.1
Gram stain Done	Yes No	77 119	39.3 60.7
Gram stain result	Positive Negative	11 185	5.6 94.4
protein level	protein >1g/L protein </=1 / 0.5 g/L	83 113	42.3 57.7
Glucose level	glucose level 40 or less glucose level>40mg/dl	180 16	91.8 8.2
AFB done (n=135)	Yes No	55 141	28.1 71.9
AFB result (n=55)	Negative Undifferentiated	42 154	21.4 78.6
Other investigation			
Hydrocephalous	Yes No	2 194	1 99

Outcomes

Of all pediatric meningitis cases reviewed, 159 (81.1%) had good outcomes (discharged after improvement) and 37(18.9%), had bad outcomes (developed complication 10[5.1%], refer to higher level of care 2[1%], left against medical advice 17[8.7%], and death 8[4.1%] were observed).

Factors associated with poor outcomes of meningitis

Among variables: age, corticosteroid administration, nutritional status, clinical condition at admission, seizure, level of temperature, level of consciousness, and respiratory distress; clinical condition at admission, and seizure were associated with poor outcome of pediatric meningitis.

Children who were a worse clinical condition at admission 6 times more likely to develop [AOR= 6.32(2.12, 18.84)] bad outcomes and those who had seizure 19 times more likely to develop bad outcomes [AOR=18.95(6.68, 53.80)] as shown in Table 4.

Table 4: Factors associated with poor outcomes of meningitis in pediatric patients who were admitted in DMRH from January1, 2017 to December30, 2018

Variables		Final outcome (Count & %)		COR (95%CL)	AOR (95%CL)	P-value
		Good	Bad			
Clinical condition at admission	Worse Better	43(27%) 116(73%)	18(48.6%0 19(51.4%)	2.556(1.227,5.322) 1	6.321(2.121,18.837) 1	0.001*
Seizure	Yes No	29(18.2%) 130(81.8%)	28(75.7%) 9(24.3%)	13.964(5.949,32.697) 1	18.953(6.677,53.799) 1	0.000*

* Statistically significant, AOR= adjusted odds ratio, COR= crude odds ratio, CI= Confidence interval

Discussion

The outcomes of this study were good or bad. In this regard, 157(81.1%) of them were improved and discharged after improvement (good outcome) and 18.9 % were a bad outcome. Among these, 10(5.1%) developed complications, 2(1%) referred to higher-level for brain imaging (CT scan), 17(8.7%) left against medical advice after the clinical conditions worsened and 8(4.1%) died. A similar study was conducted in Fleeger Hiwot Referral Hospital and Brazil, 19(10.6%) and 2(5.7%) had complications of cranial nerve involvement that led to an oculomotor problem (nerve palsies), and 0.6% and 2.9% were for paralysis respectively [13, 15]. Also, a study conducted in Fleeger Hiwot Referral Hospital showed that 15% of pediatric meningitis cases developed poor outcomes and referred to higher facility 4.5%, and death 3.4% was stated thus, it was a better outcome than this study area [13]. This different outcome could be the difference in institutional capacity and other risk factors in the study area.

In this study, meningitis was common from 1month to 1 year of age, which accounted for 52% of pediatric meningitis cases. A similar study conducted in Pakistan showed that 68.3% were infants [12], and a study in Turkey showed that the highest incidence was in children 1–12 months of age [5].

The current study indicates that 56.6% of the study partic-

ipants lived in rural areas. This is different from the study conducted in Fleeger Hiwot Referral Hospital, the residents of pediatric patients were urban (67%) and Nepal was urban (88.1%) [13, 14]. This may be due to demographic, socio-cultural, and economic differences between people in the study area.

This study showed that most of pediatric meningitis were admitted in the spring season, which was 36.7%. A similar study conducted in Iran showed that most meningitis patients were admitted in the spring season[15]. This may be due to temperature, humidity level, pressure, wind, and dust during the season.

Malnutrition is one of the risk factors that can expose to the development of meningitis[11]. This study indicated that about 21% of the patients were malnourished. A similar study was conducted in Fleeger Hiwot Referral Hospital indicated that 18% of the patients were malnourished [13]. In the study conducted in Libya and India, only 0.2% and 2.4%, respectively, were malnourished [6]. This showed that there was a relatively high rate of malnutrition in the current study. This difference might be due to demographics, socio-cultural and economic differences between people in the different study areas and community awareness about childhood feeding practices in a different area.

In this study, 45.4% of the participants completed their vaccination. A similar study was conducted in the Fleeger Hiwot Referral hospital, and 49.4% of children completed their vaccination[13]. In contrast, in a study conducted in Turkey, 91.3% of the immunization status was completed [15]. This difference might be due to community awareness about the risk factors of pediatric meningitis.

Different infections or diseases can be a risk for the development of meningitis. Among these, HIV/AIDS, tuberculosis, cerebral malaria, and sepsis are the most common. This study indicated that 0.5% of the patients were co-infected with HIV/AIDS. Research done at Fleeger Hiwot Referral Hospital showed that 4.5% & 2.2% and in Nigeria, 2.1% and 4.5% were co-infected with HIV/AIDS and tuberculosis, respectively,[13, 16, 17]. The difference might be a variation in socio-demographic and study design.

Most of the clinical presentations and physical examinations in this study were fever (86.87%), vomiting (83.7%), respiratory distress (42.9%), loss of consciousness (54.6%), and seizure (28.1%) . About 28.2% had positive Brudinski & Kerning signs, and 38.7% of them had positive neck stiffness. A similar study was done on Fleeger Hiwot Referral Hospital, 93.1% was febrile, 91.1% had vomiting, 22.9% were in respiratory distress, 30.7% had positive Brudinski & Kerning signs, 28% of them had positive neck stiffness, and 59.7% patients lost their consciousness [13].

Laboratory investigations of CSF specimens in suspected cases of meningitis are extremely important for prompt diagnosis and management of patients[6]. In this study, all patients were investigated for their CSF, and among them, 84 (62.2 %) of meningitis patients had an elevated level of WBC. Similar studies were done Fleeger Hiwot Referral Hospital, and in Taiwan indicated that most admitted patients tested their CSF, 98.3% and 83.8 % had elevated WBC, respectively [13, 18].

Gram stain examination of CSF permits rapid, accurate identification of the causative bacterium in 60%–90% of patients with meningitis[6]. In contrast to this, the current research gram stain on CSF provided 11(5.6%) meningitis pediatric patients were positive. It was less than that of Felege Hiwot Referral Hospital, which was about 32(30.2%). The difference might be due to the variation of etiology and difference in the study area.

In this study, 29.1% study participants developed seizures and children who had seizures were almost 19 times more likely to develop bad outcomes [AOR=18.953(6.677, 53.799)] than their counterparts. Studies Fleeger Hiwot Referral Hospital and in Norway, it wasn't a determinant factor for the outcome [19]. Because they classified seizures as a short course and prolonged seizure.

This study showed that children with the worse clinical condition at admission developed 6 times more likely to develop bad outcomes as compared to cases admitted in a better condition [AOR= 6.321(2.121, 18.837)]. This finding is similar to other studies conducted in Felege Hiwot Referral Hospital; children with a worse clinical presentation were almost 9 times more likely to develop poor outcomes [AOR= 8.779 (1.599, 48.192)] [13]. This is also comparable may be due to the effect of a difference in ethological and cases of demographic variation.

Conclusion

In summary, the clinical outcomes of pediatric meningitis in this study area were poor as compared to other hospitals. One in five pediatric meningitis cases in this study area had a bad outcome. seizures and worse clinical conditions at admission were factors identified for poor pediatric meningitis outcomes.

Recommendation

- Hospital and Health Department should create awareness among the health care workers to give intensive care for pediatric patients presenting with a worse clinical presentation and seizure.
- Health workers should create community awareness about each risk factor and early health seeking-practice to improve clinical outcomes.
- Researchers should do further study on identification of causative agents and antibiotic susceptibility to improve outcomes related to causative agents.

Limitation of the study

- The study was based on secondary data (chart review) and may not display all factors that were not documented in the patient's files.
- There weren't presenting about the types of meningitis that helped to see the outcomes related to causative agents.

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medical records securely.

Declarations

Ethics approval and consent to participate: Ethical approval was obtained from Debre Markos University Collage of Health Science Research Ethical Committee. Permission letter was obtained from Debre Markos comprehensive specialized referral hospital for data repository. The necessary explanation regarding to the purpose of the study was informed to data collectors and concerned official bodies in the hospital. Verbal waiver agreement was obtained from the medical director of the hospital to access the medical records of child meningitis. Confidentiality during all phases of research activities was kept, and data were held on a secured encrypted system. This study was conducted in accordance with the Declaration of Helsinki. Confidentiality of the information was assured by not recording patients' names from the chart, and the privacy of the information was maintained.

Consent to publish

"Not applicable"

Availability of data and materials

"The dataset will not be shared to protect the participants' identities"

Competing of interests

The authors declare that they have no competing of interests.

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Author's contributions

ZS conceived and designed the study and performed the analysis. HA participated in designing, supervising, reviewing, and analyzing the study; and prepared this manuscript. HA finally reviewed the design, analysis, and discussion through their critical comments at each step of the research. We all reviewed this manuscript.

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