ORIGINAL ARTICLE

ASSOCIATIONOF CRANIAL ULTRASOUND FINDING WITH CLINICAL PRESENTATION OF COMPLICATION OF NEONATAL MENINGITS AT FELEGE HIWOT HOSPITAL

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ABSTRACT

Background: *Meningitis is the acute inflammation of the meninges, subarachnoid space, and brain vasculature resulting from infection. Regardless of etiology, meningitis in neonates can progress rapidly to serious acute complications. Apart from laboratory tests, cranial sonography is the first modality used for diagnosing as well as detecting early and late complication of neonates and infants with suspected bacterial meningitis. In our hospital cranial ultrasound (CU) is done for every neonate with meningitis.*

Objectives: *To determine the association of cranial ultrasound finding with clinical presentation of early complication of neonatal meningitis at Felege hiwot Comprehensive Specialized Hospital in Bahir Dar.*

Method: *A retrospective study that employed document review. Neonates were grouped in to two, Group I: neonates with no clinical feature of complication,Group II: neonates with clinical evidence of complication.*

Result*: A total of 83 neonates with a diagnosis of meningitis for whom cranial ultrasound were reviewed. Of these 43(51.8%) were males. The most common clinical presentation was increased head circumference in 11(57.9%) and bulged fontanel in 10 (52.6%) of neonates. CU was normal in 69 (83.1%) and abnormal in 14 (16.9%) of neonates. The commonest indication for CU was screening 64 (77.1%), and the remaining 19 (22.9%) neonates had clinical features of complication of meningitis. The most common complication of meningitis was hydrocephalus 13 (92.8%).*

Conclusion*: Abnormal CU finding is high in neonates who had early signs of complication of meningitis.*

Keywords*: Cranial ultrasound, neonatal meningitis, complication of meningitis*

INTRODUCTION

Meningitis is the acute inflammation of the meninges, subarachnoid space, and brain vasculature.(1). Neonatal meningitis is typically happening between birth and the first 28 days of life(2). Neonatal meningitis is categorized as early and late onset, which is defined by the presence of signs of infection and organism

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isolation from cerebrospinal fluid (CSF) cultures at less than or equal to 72 hours and greater than 72 hours of life, respectively(1).

Meningitis is more common in the neonatal period than any other time in life and is an important cause of morbidity and mortality globally(3).The incidence of neonatal meningitis varies by geographic location. The incidence of culture-proven neonatal meningitis is estimated at 0.3 per 1000 live births in developed countries.In developing countries, the reported incidence of neonatal meningitis is much higher at 0.8 to 6.1 per 1000 live births, with a mortality of 40% to 58%. True values may be higher because of underreporting in regions with limited resources, diagnostic testing, and access to health care (1, 4)

Neonates with bacterial meningitis usually present with subtle, variable, or nonspecific features. These features might include fever, hypothermia, lethargy, poor feeding, irritability, vomiting, diarrhea, respiratory distress, seizures, or bulging fontanels. CSF examination is essential to establish the diagnosis of bacterial meningitis and to identify the causative organism and undertake in vitro antibiotic susceptibility testing. CSF culture is the gold standard for diagnosis of meningitis. (5)

Regardless of etiology, meningitis in neonates can progress rapidly to serious acute complications. These include cerebral edema; hydrocephalus; hemorrhage; ventriculitis, especially with bacterial infection; and cerebral infarction. Subdural effusions, empyema, leptomeningeal scarring and fibrosis, and arachnoiditis (6). Early diagnosis and treatment are key aspects for the patient's prognosis. Apart from lab-oratory tests, imaging procedures are also important for the diagnostic process. Sonography should be among the available methods as the first modality used in diagnosing neonates and infants with suspected bacterial meningitis and the detection of early and late complications of bacterial meningitis(8). Cranial ultrasound imaging can be unaltered in patients with uncomplicated bacterial meningitis. In neonates and infants with severe neurological symptoms sonographic abnormalities are observed in up to 100% of patients (8).

Cranial ultrasound is a safer, cost effective, the most widely available cranial imaging modality in the neonatal intensive care unit. It is a non-invasive excellent technique for detecting the most frequently occurring brain abnormalities in preterm and full-term neonates (9-15). All the above acute complications can be detected by early using cranial ultrasound. In our neonatal intensive care unit (NICU), in addition to neonates having clinical evidence of early complication of meningitis but also neonates who completed their treatment usually screened with cranial ultrasound to identify clinically undetected complications . So, doing CU for all neonates will increase the waiting time to see a radiologist and the other newborn with

complication of meningitis will not be detected timely and will have increased neurologic sequels. It is also wastage of resources.

In Ethiopia, there is no research done on this topic. So this study helps to determine which patient should have cranial ultrasound timely to diagnose early complications and helps to develop guideline for health institutions with available resource and it can be a base line for prospective study.

METHODS AND MATERIALS

Study area and period

The study was conducted in Felege Hiwot Comprehensive Specialized Hospital which is found in Bahir Dar city,Amhara regional state,Ethiopia. The hospital has four major departments which are Internal medicine, surgery, obstetrics & gynecology and pediatric ward. It also had minor departments that are ophthalmology, ENT, psychiatry, dermatology, and radiology .Pediatrics and child health is among the 4 major departments having its neonatal intensive care unit (NICU) with 50 beds divided separate room for term, preterm, kangaroo mother care, and stable newborn side.

Study design

Hospital based retrospective study that employed document review from 02/9/2019 to 30/9/2019.

Source population

All neonates admitted with a diagnosis of neonatal meningitis during January 1, 2018 to December 30, 2018.

Study population

All neonates admitted with a diagnosis of neonatal meningitis and had cranial ultrasound during January 1 to December 30, 2018.

Exclusion criteria

- Neonates who had congenital or acquired CNS abnormalities (e.g.neural tube defect, intraventricular hemorrhage) .
- Neonates who had cranial ultrasound which was not done by radiologist .
- Neonates who had incomplete documentation.

Sample size

Due to relatively small number of patients with neonatal meningitis, all patients were included. All charts of neonates who stayed for more than 21 days during January 1 to December 30, 2018 was selected and revised. All neonates with meningitis and had cranial ultrasound were selected. Over one year a total of 426 neonates stayed greater than 21 days in NICU. From these167 neonates was treated for meningitis, including health care associated meningitis. Of those neonates 83 had cranial ultrasound. Finally neonates were grouped in to two, as Group I consists of neonates with no clinical manifestation or suspicion of complication and Group II consists of neonates with clinical evidence of complication.

Data collection instrument

Data collection was done from 02/9/2019 to 30/9/2019 using pre tested questioner which

was filled by trained medical professional who was trained for one day and assisted by a trained supervisor.

Data quality

The questioner was pre tested before the actual data collection started. The supervisor was guiding the data collectors throughout the data collection process.

Data processing and analysis

The checklist was checked for completeness and was cleaned manually. Data collected by checklist was coded, entered, cleaned and analyzed using IBM SPSS statistics data editor version 20. Data was cleaned by running frequencies of all the variables to check for incorrect coding. Frequency and cross tabulations were used to summarize descriptive statistics of data, and tables were used for data presentation. Chi-square was done to check associations of variables.

Operational definitions

Diagnosis of neonatal meningitis: CSF white blood cell count greater than 20-30 cells/μL; clinical high index of suspension of meningitis in situations where doing CSF analysis were difficult or contraindicated; in bloody CSF WBC:RBC ratio, subtract 1 WBC in every 500-1500 RBCs(25).

Ethical consideration

Letter was obtained from ethical committee of Bahir Dar University College of Medicine and Health science,and written consent was brought from medical director bureau of Felege Hiwot Comprehensive Specialized Hospital. Confidentiality of information obtained from patients' documentation was maintained and secured.

RESULT

Among the total of 3572 neonatal admissions, 426 neonates stayed for more than 21 days in NICU. From these, 167 neonates were treated for meningitis and 83 neonates had CU. Neonates who had CU accounts 2.3 % of all neonatal admission and 19.4 % of neonates stayed for more than 21 days. The age distribution of studied neonates ranged from 1 day to 24 days and mean and standard deviation for agewas 5.6 ± 6.2 days respectively. From neonates studied 43 (51.8%) were males with a male to female ratio of 1: 1.1. Group I (n = 64, 77.1%) consisted of neonates with no clinical manifestation or suspicion of complication and Group II (n = 19, 22.9%) consisted of neonates with clinical evidence of complication. CU was done at the FHCSH in 56 (67.5%) newborns and at private center in 27 (32.5%) neonates with in a minimum of 1 day and a maximum of 18 days after a diagnosis of meningitis.

The most common indication for having CU was screening for detecting complication of meningitis in 64 (77%) and the remaining 19 (22.9%) neonates had different clinical features of complication of meningitis. The most common presenting clinical feature for indication of CU in Group II neonates was increased head circumference (HC)(11, 57.9%) followed by bulged fontanel (10, 52.6%) (Table 1).

Table 1. Combination of presenting clinical features for an indication of CU in Group II nenates in Felegehiwot comphrensive specialized hospital(n =19), from January 1 to December 2018

Presenting complaints	**No**	**%**
Increased HC	4	21.05
Increased HC, bulged fontanel	3	15.80
Increased HC, bulged fontanel, sutural diastasis	3	15.80
Bulged fontanel	2	10.53
Bulged fontanel, sutural diastasis	1	5.26
Increased HC, sutural diastasis	1	5.26
Uncontrolled seizure	1	5.26
Persistent fever, bulged fontanel	1	5.26
Sutural diastasis	1	5.26
Decreased consciousness, affected primitive reflex	1	5.26
Persistent fever, uncontrolled seizure, decreased consciousness, affected primitive reflex	1	5.26
Total	19	100

Pattern of cranial ultrasound finding

Cranial ultrasound was done with a minimum of 1 day and a maximum of 18 days after meningitis is diagnosed .Cranial ultrasound was normal in 69 (83.1%) and abnormal in 14 (16.9%) of neonates .CU was normal in 63(98.4%) neonates in Group I and 6 (31.6%) neonates in Group II. One (1.6%) neonate showed abnormal CU in Group I and 13 (68.4%) neonates in Group II.

The most common abnormal CU finding was hydrocephalus 13 (92.8%) and 1 neonate in Group I and 12 neonates in Group II. Two (14.3%) showed ventriculitis and 1(7.1%) showed subdural effusion, all the 3 were in Group II neonates. Two neonates had both hydrocephalus and ventriculitis (Table 2).

Table 2. Pattern of neonatal meningitis complication detected by CU in Felegehiwot comphrensive specialized hospital (n = 14), from January 1 to December 2018

Complication	**Group I (Total 64, normal 63, abnormal 1) 1)**	**Group II (Total 19. Normal 6, abnormal 13)**
Hydrocephalus	1 (mild hydrocephalus)	12
Ventriulitis	0	2
Subdural effusion	0	1
Brain abscess	0	0

Correlation of indication of CU with CU findings

Since the variables are categorical, chi-square test was used to see association between indication of CU and CU findings (Table 3).

Table 3. Association of indication of CU with CU finding in Felegehiwot comphrensive specialized hospital (n = 83), from January 1 to December 2018

		Indication for CU		P value
		Screening	Sign of complication	
CU finding	Normal	63	6	.000
	Abnormal	1	13	.000

DISCUSSION

In this study the most common indication for having CU was as a screening in neonates for detection of complication of meningitis although it is done in neonates with different presenting compliant. Out of 19 neonates the most common clinical feature was increased head circumference 11(57.9%) followed by bulged fontanel 10 (52.6%) which was seen in patients who develop hydrocephalus. This result is similar in research done in Nigeria which showed that most patients presented with suspicion of hydrocephalus 34 (29.8%) (24).In this study the most common CU finding was normal in 69 (83.1%) neonates and abnormal in 14 (16.9%) neonates, and from the abnormal CU results the most common was hydrocephalus in 13 (92.8%) neonates. which is comparable with a study done in India and Nigeria, (5, 19-23) that only involve neonates with clinical suspicion of complication of meningitis the most common result of CU was normal 54 (47.37%) and hydrocephalus in 43 (37.72%)(24). The other abnormal CU finding was ventriculitis in 2 (14.3%) of neonates which is similar with other researches (20-24).Only one neonate in Group I had abnormal CU finding which is lower compared with research done in India that shows 19 out of 39 patients with no clinical manifestation of complication had abnormal CU finding . The possible reason could be majority of CU was done after first week of diagnosing meningitis but in the Indian CU was done in all patients at day 1, day3 and 10 days or completion of antibiotic therapy (20).

The probability of having normal CU finding is high in neonates who had not signs of complication of meningitis and the probability of having abnormal CU findings is high in neonates who had signs of complication of meningitis.

This study showed that most of the CU was done at the government hospital, and had prolonged time to be seen by radiologist. So this unnecessary cost and delay could be managed by doing CU for selected patients.

Limitation

This study is one site study and being a retrospective design, it may not be representative.

Conclusion

The most common indication for having CU was screening.CU is an important diagnostic modality to detect early complication of meningitis in neonates who had signs of complication The most common complication of neonatal meningitis detected by CU was hydrocephalus. Majority of neonates had CU at hospital with a waiting time to see a radiologist was 3 ± 3.7 days. Neonates who develop health care associated meningitis constitute the majority of complications detected by CU.

Recommendation

It is recommended to do CU for neonatal meningitis who have clinical suspicion of complication rather than using for screening purpose at the end of treatment. Since it is a retrospective study, it may not be representative of the actual correlation of clinical presentation of complications and of CU findings, so prospective study is recommended.

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