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Laboratory finding of CSF analysis in patients with meningitis at Elamin Hamid Pediatrics Hospital in Khartoum, Sudan

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Abstract

Bacterial meningitis in infants and children is a serious clinical entity with signs and symptoms that commonly do not allow distinguishing the diagnosis and the causative agents. The only method to determine if meningitis is the cause of these symptoms is a lumbar puncture. Lumbar puncture is the gold standard for the diagnosis and should be done in all suspected cases of meningitis unless contraindicated.

Objectives: The purpose of this study is to identify the importance of the microbiological study of cerebrospinal fluid (CSF) in patients suspected to have acute meningitis. Despite the availability of all other investigations and Imaging for diagnosis of meningitis but CSF analysis remains the most available, accurate, and cheaper for diagnosis of meningitis in children.

Methodology and result: This is a prospective study. 71 patients were included. All patients were clinically suspected to have acute meningitis. A lumbar puncture for CSF analysis was done for all patients. The data was collected and analysed. CSF culture was done. The culture was negative In 58 patients (81.7%) and positive in 13 patients (18.3%). Streptococcus was found in 3 patients (4.2 %), staphylococcus epidermidis in 2 patients (2.8%), E Coli in 2 patients (2.8%), klebsiella in 2 patients (2.8%), pneumococci in 2 patient (2.8%), salmonella in 1 patient (1,4%) and Bacilli in 1 patient (1.4 %).

Recommendation: Lumbar Puncture (LP) remains the easiest, cheapest and accurate investigation for diagnosis of meningitis in children mainly in rural areas in Sudan and other developing countries. It's mandatory to offer training for doctors and medical staff for doing lumber punctures safely and accurately and to offer well-equipped laboratories for such essential investigations. It's not only the role of doctors and medical staff but is a governmental obligation as well. This can save a lot of sick children and prevent mortality and morbidity of acute meningitis in children.

Keywords: CSF analysis; Meningitis; Sudan; Lumbar Puncture

1. Introduction

Bacterial meningitis in infants and children is a serious clinical entity with signs and symptoms that commonly do not allow distinguishing the diagnosis and the causative agents. Meningitis is usually caused by a bacterial or viral infection that invades the cerebrospinal fluid (CSF). Fungi and parasites may also cause meningitis. The severity of symptoms and prognosis depends on the specific organism that causes meningitis. Meningitis can occur in infants, children, and

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adults. Some bacteria and viruses are more common in certain age groups than others (1) Pediatric bacterial meningitis is a life-threatening illness that results from bacterial infection of the meninges and leaves some survivors with significant sequelae. Therefore, meticulous attention must be paid to appropriate treatment and monitoring of patients with this disease (2).

Headache, neck stiffness, and photophobia are classic symptoms of septic meningitis in older children. These symptoms may be absent in younger children who more commonly present with rash, diarrhea, cough, and fever may be present. Seizures are more common in aseptic meningitis caused by specific viruses (e.g. arbovirus). Symptoms seen with neonatal meningitis are often nonspecific that may point to several conditions, such as sepsis. This can include fever, irritability, and dyspnea. Other nonspecific symptoms may include arthralgia, myalgia, sore throat, weakness, lethargy, and hypotonia (2). The only method to determine if meningitis is the cause of these symptoms is a lumbar puncture (3). Lumbar puncture is the gold standard for the diagnosis and should be done in all suspected cases of meningitis unless contraindicated (4). It helps to distinguish the microbial aetiology of meningitis and encephalitis and to rule out non-infectious causes of disease. Besides fever and convulsions as indicators for CSF studies, clinical parameters such as irritability, lethargy, and sick-looking appearance are better indicators of meningitis, especially those below 18 months of age. The most common causes of neonatal meningitis are septicemia (bacteremia) specifically Group B Streptococci (Streptococcus agalactiae), Escherichia coli, and Listeria monocytogenes. Although there is a low mortality rate in developed countries, there is a 50 % prevalence rate of neurodevelopmental disabilities in E. Coli and GBS meningitis, while having a 79 % prevalence for non – E Coli Gram-negative meningitis. Delayed treatment of neonatal meningitis may cause neurological deficits to include cerebral palsy, blindness, deafness, and learning disability (3).

Acute meningitis is a common infection, predominantly aseptic, but when it, s bacterial origin, it's significantly associated with severe neurological sequelae, especially when the diagnosis and treatment are late. As it is difficult to distinguish between bacterial and aseptic meningitis in the initial state, most authors have recommended rapid initiation of antibiotic therapy until cerebrospinal (CSF) culture results become available, 47 – 72 hours later (5.**6**). The pattern of bacterial meningitis and its treatment during neonatal periods may overlap, especially in the first one to three months old in when group B streptococcus, Hemophilus influenza – type B, meningococcus, and pneumococcus all produce meningitis. In children more than 3 months of age H. influenza, Streptococcus pneumonia, Neisseria meningitides are the commonest causative organism of bacterial meningitis (7). A Lumber puncture (LP) is necessary for the diagnosis of meningitis. Cerebrospinal fluid (CSF) culture is the most important study for the diagnosis of neonatal bacterial meningitis because clinical signs are nonspecific and unreliable as well. Lumbar Puncture should be done in all neonates with suspected meningitis, with suspected or proven sepsis, and should be considered in all neonates with a possibility of sepsis.

2. Methodology and results

The study was conducted at Mohamed Elamin Hamid Pediatric Hospital, in Omdurman City, in Khartoum State in the period from August 2017 to January 2018. The populations of this study are all patients clinically suspected to have acute meningitis and lumbar puncture for CSF analysis was performed. The total number of patients was 71 patients were included. The type of the study is a prospective study, the data was collected and analyzed. Males were 40 (56.3 %) and females were 31 (43.7 %) (table1). Neonates less than one month were 6 (8.5%), infants 1 - 12 months were 33 (46.5%), children 1 – 5 years were 29 (40.8 %) and children more than 5 years were 3 (4.2 %) (table2). The majority presented with fever 69 (97.2%), convulsion 65 (91.5 %), irritability In 26 (36.6 %), headache in 5 (7.0 %) , Photophobia in 2 (2.8 %) , Neck stiffness in 6 (8.5%), Bulging fontanel in 13 (18.3 %), kerning's sign was positive in 1 (1.4 %) and Brudzinski's sign was positive in 1 (1.4 %) (table3).

Regarding the CSF appearance: CSF is clear in 57 (80. 3%), turbid in 13 (18.3%) and bloody in 1 (1.4%) (table4). Related to CSF sugar content: CSF sugar less than 50 mg/dl in 17 (23.9%) between 50 – 75 mg/dl in 54 (76.1%) and no one has more than 75 mg /dl (0 %). Regarding CSF Protein: less than 5 mg/dl not found (0.0 %), between 15 – 45 mg /dl were 51 (71.8 %), more than 45 mg/dl were 20 (28.2 %). The cell distribution: WBCs less than 5 in 52 (73.2 %), between 5 – 10 were 15 (21.1%), more than 10 were 4 (5.6 %). RBCs were less than 5 in all 71 patients (100%). Polymorphs were less than 70% in 52 of patients (73.2%) and more than 70% in 19 (26.8 %). Lymphocytes were less than 30 % in 54 (76.1%) and more than 30% in 17 (23.9%). CSF culture was done: culture was negative in 58 of patients (81.7%) and positive in 13 of patients (18.3%). Of these positive culture: Streptococcus pneumoniae was found in 3 patients (4.2%), Staphylococcus epidermidis in 2 (2.8%), E. coli in 2 (2.8%), Klebsiella in 2 (2.8%), Pneumococci in 2 (2.8%), Salmonella in 1 (1.4%) and Bacilli in 1 (1.4 %).

Table 1 Sex distribution

Sex	No	Percentage
Males	40	56 .3 %
Females	31	43.7 %

Table 2 Age distribution

Age	No	Percentage
Less 1 Month	6	8.5 %
1 Month – 1 Year	33	46.5 %
1 - 5 Years	29	40.8 %
Above 5 Years	3	4.2 %

Table 3 Clinical picture on presentation

Symptoms and Signs	Frequency	Percentage
Fever	69	97.2 %
Irritability	26	36.6 %
Headache	5	7 .0 %
Photophobia	2	2.8 %
Neck stiffness	6	8.5 %
Convulsion	65	91 %
Bulging Fontanels	13	18.3 %
Kerning Sign	1	1.4 %
Brudzinski Sign	1	1.4 %

Table 4 CSF Appearance

CSF Appearance	Frequency	Percentage
Clear	57	80.3 %
Turbid	13	18 .3 %
Bloody	1	1.4 %
Total	71	100 %

Table 5 Distribution of CSF Glucose level

CSF Glucose level	Frequency	Percent
Less than 50 mg/dl	17	23.9 %
50 – 75 mg/dl	54	76.1 %
More than 75 mg/dl	0	0.0 %
Total	71	100.0 %

Table 6 Protein level distribution of CSF

CSF Protein level mg/dl	Frequency	Percent
Less than 15 mg /dl	0	0.0 %
15 – 45 mg/dl	51	71.8 %
More than 45 mg / dl	20 l	28.2 %
Total	71	100.0 %

Table 7 Cell distribution of the CSF

Cell counts	Categories	Frequency	Percent
WBCS	. Less than 5.	. 52	. 73.2 %.
	. 5 – 10.	. 15	. 21.1 %.
	. More than 10.	. 4	. 5.6 %.
RBCs	. Less than 5.	. 4.	. 71 %.
	. More than 5.	. 71	. 0.0 %
Polymorphs	. Less than 70 %.	. 52.	. 73 .2 %.
	. More than 70 %	. 19.	. 26. 8 %
Lymphocytes	. Less than 30 %.	. 54.	. 76.1 %.
	. More than 30 %.	. 17.	. 23.9 %

Table 8 Distribution of CSF Culture

CSF Culture	Frequency	Percent
Negative	58	81. 7 %
Positive	13	18. 3 %
Total	71	100.0 %

Table 9 CSF Culture results

Type of organism	Frequency	Percent
Streptococcus pneumoniae		4.2 %
Staphylococcus epidermidis	2	2.8 %
E. Coli	2	2.8 %
Klebsiella	2	2.8 %
Pneumococci	2	2.8 %
Salmonella	1	1.4 %
Bacilli	1	1.4 %
No growth	58	81.7 %
Total	71	100.0 %

3. Discussion

The purpose of this study is to identify the important role of the microbiological study of CSF in children suspected to have acute meningitis. Despite the availability of all other investigations and imaging for diagnosis of meningitis but CSF analysis remains one of the best available, accurate and cheaper for accurate diagnosis of meningitis in children. In our study: it was found that males were 40 (56.3 %) and females were 31 (43.7 %) which similar to American study by Negrini B et al where males were (61 %) while females were (39%)[8] as well as in Nigerian study by IA Lagunji et al where males were 63.9% and females were (36.1%)[9]. On the contrary to the study from Portugal by Sofia Águeda et al that showed a reverse ratio where male were only (39.7 %) and female is (60.3 %) [10].

Regarding CSF analysis we found that it was septic in 13 (18.3 %) and aseptic in 58 (81.7 %) which is similar to studies by Nigrovic LE et al in Boston, USA where they found the same result (bacterial meningitis in 18% and aseptic in 82% of cases ([11]) and the study by Tatara R et al in Japan where they found septic in 10-20% and aseptic meningitis in 82 – 90% ([11] & [12]). The causative agent in our study was found to be Streptococci pneumoniae in 3 of patients (4.2%), Staphylococci epidermidis in 2 (2.8%), E coli in 2 (2.8%), Klebsiella in 2 (2.8%), Pneumococci in 2 (2.8%), Salmonella in 1 (1.4%) and Bacilli in 1 (1.4 %). There was no Neisseria meningitidis isolated.

Unlike the other studies in USA by Negrini B et al where they found the majority was caused by Neisseria meningitidis (48.4%), Streptococci (9.7%) and other bacteria in 9.7% (8). Similarly the study in Greece by Karanika M et al found Neisseria meningitidis in 63.0%, Hemophilus Influenzae in 18.9%, Streptococci pneumonia in 14.0% and other bacteria in 4.1 % (13). On the other hand, a Nigerian study by IA Lagunji et al they found Hemophilus influenzae type b (Hib) was the leading pathogen that found in 16 (55.1%) of the 29 cases of definite meningitis, other isolates included Streptococcus pneumoniae (24.1%), Klebsiella (7.0%), Staphylococcus aureus (7.0%), Escherichia coli (3.4%) and Pseudomonas spp. (3.4%) (14).

4. Conclusion

Acute meningitis is a common infection in neonates, infants, and children. The clinical picture of meningitis is similar to the other febrile illnesses while meningitis is a serious condition and it is a life threatening with permanent sequelae. Therefore should be differentiated urgently from other diseases, with more accurate and available investigation mainly in rural areas whereas we know there is a deficit of resources and trained staff mainly in developing countries as our country, Sudan.

The availability of trained doctors and staff to do LP safely and accurately, laboratories with facilities for accurate investigation are all needed in developing countries to decrease morbidity and mortality. Other investigations are expensive and cannot be afforded by most families in recent years. Therefore lumbar puncture remains the gold standard investigation for diagnosis of meningitis in developing countries, mainly in rural areas. It's not only the role of doctors and medical staff but is a governmental obligation as well to re-enforce and encourage the practice of lumber puncture in suspected cases. This can save a lot of sick children and prevent mortality and morbidity of acute meningitis in children.

Compliance with ethical standards

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Disclosure of conflict of interest

None to disclose.

Statement of informed consent

Informed consent was obtained from all guardians of children included in the study."

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