ANALYSIS OF THE INDICATIONS AND RESULTS OF CEREBROSPINAL FLUID EXAMINATION IN CHILDREN ADMITTED TO THE PAEDIATRIC WARDS OF TWO HOSPITALS IN EAST AFRICA

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Objectives: To compare indications for lumbar puncture and findings of cerebrospinal fluid examination in children admitted at Muhimbili National Hospital (MNH) in Dar-es-salaam, Tanzania and Kilifi District Hospital (KDH) in Kenya

Study design: A descriptive, cross-sectional hospital based study.

Setting: Paediatric wards of Muhimbili National Hospital (MNH) in Dar es Salaam and Kilifi District Hospital (KDH) in Kenya.

Results: Overall, 8,741 paediatric admissions were recorded in the two hospitals; (Muhimbili = 6,228; Kilifi= 2,513). Of these, 607 (6.9%) had an LP performed; 154 out 6,228 (2.5%) from MNH and 453 out of 2,513 (18.0%) at KDH. The most common indications for lumbar puncture at MNH were convulsions (61.4%), neck stiffness (14.3%) and prostration (17%), whereas at KDH were convulsions (56.3%), neck stiffness (7.3%) and prostration (22.1%). The bacterial isolates were rarely (2.3%) obtained on culture at both hospitals. *Streptococcus pneumonae* and Salmonella species were the commonest causes of pyogenic meningitis.

Conclusion & recommendations: Lumbar punctures are performed less frequently at Muhimbili than Kilifi Hospital. Pneumoccocus and Salmonella species are the commonest causes of pyogenic meningitis. Strategies should be put in place to improve the rates of lumbar puncture at MNH and the isolation of bacterial pathogens from cerebrospinal fluid cultures in both hospitals. Other possible causes for meningitis such as viruses need to be investigated.

Key words: lumbar puncture, cerebro-spinal fluid, children, infections, Tanzania, Kenya

Introduction

A lumbar puncture (LP) is a procedure performed to collect a sample of cerebrospinal fluid (CSF) for biochemical, microbiological and cytological analysis. This technique is important in the diagnosis of a variety of infectious and non-infectious neurological conditions. The most common indication for a lumbar puncture is to collect cerebrospinal fluid in a case of suspected bacterial meningitis. Lumbar punctures are also performed to administer intrathecal medications like spinal anaesthesia.

At Muhimbili National Hospital (MNH), indications for LP have been adapted from the Integrated Management of Childhood Illnesses (IMCI) Guidelines. In neonates these include fever (≥38.5ºC) or hypothermia, bulging fontanelle (or acute increase in head circumference), high-pitched cry, irritability, lethargy, altered mental state and poor feeding. Bacterial meningitis is usually suspected in a patient (>3 months including adolescents) with a history of fever and headache, photophobia, stiff neck, irritability or lethargy, vomiting and altered state of consciousness or a convulsions. In such patients, LP is indicated. Patients are usually initiated on treatment with antibiotics and antimalarials targeting suspected bacterial meningitis and severe malaria often before the LP is performed. This is because of delays may be associated with processing and obtaining LP results. At the Muhimbili National Hospital pathogens are isolated from very few CSF specimens. This has limited the utility of CSF results in guiding treatment among clinicians who hardly get positive results (G. Herbert, unpubl)

At Kilifi District Hospital (KDH) in coastal Kenya, LPs are indicated in patients with altered level of consciousness, history of convulsions in a child <2 years or prostration in children <3 years. It is also performed as part of septic screening in neonates. This hospital currently serves as a Centre of excellence in monitoring invasive haemophilus and pneumoccocal (bacteraemia and meningitis) in Kenya.

Acute bacterial meningitis (ABM) is an important indication for lumbar puncture in most of hospitalised cases. ABM is associated with high mortality and neurological damage in children. In a partially prospective and retrospective review of data of children admitted to the Hospital with bacteria meningitis conducted in Ndala Mission Hospital in Tabora Tanzania in 2002 showed that the overall mortality due to bacteria meningitis was high (51%) (Wiersinga et al., 2004).

Data on the indication for LPs and/ or CSF examination is scarce in Tanzania. Such data are important to provide information of the level of performance in management of CNS pathology and other neurological diseases especially in this era of HIV/AIDS. The objective of this study was therefore to compare indications for LPs and CSF examination results among children admitted to MNH and KDH.

Materials and Methods

The Muhimbili National Hospital in Dar es Salaam, Tanzania and Kilifi District Hospital in Kenya were involved in the study. A retrospective review of patients who had LPs over a six-month period from November 2004 to April 2005 was conducted. This included all children admitted to the paediatrics wards and suspected to have central nervous system infections and had LPs performed.

Data was extracted from patient's clinical notes and laboratory registers held in both hard copies and electronic databases. At MNH, patients

who had a LP performed were identified from the laboratory registry and their clinical notes traced. A data sheet was constructed to collect the required information from patients files, microbiology and biochemistry laboratories. An electronic database was available at KDH. An electronic request form was filled asking specifically for data on patients who had LPs during the specified period. Variables collected included: demographic characteristics such as age and sex of the patient, symptoms and signs of CNS infections such as convulsions, unconsciousness, bulging fontanelle and neck stiffness. Results of CSF laboratory examination of sugar, protein, white blood cell count and culture were recorded.

Data were entered using Epi-Info 2002 software and Excel and analysed using version 8 of the STATA software package (Stata Corp, College Station, Texas).

Results

A total of 8,741 admissions (MNH= 6,228; KDH= 2,513) to the paediatric wards were recorded. Of these, 607 (6.9%) had a LP performed; 154 out 6,228 (2.5%) from MNH and 453 out of 2,513 (18.0%) in KDH. However 42 patients from MNH were excluded from data analysis due to data missing (files could not be traced). Therefore a total of 565 patients from the two hospitals were included in the data analysis; 112 from MNH and 453 from KDH. Most of the patients at MNH were females (60.7%) whereas males (52.8%) dominated in the number of patients admitted to KDH.

There were more females (60.7%) than males from MNH while KDH showed a slight male preponderance (52.8%). Out of the total study population 50% were aged one year below

(Table 1).

Table 1: Sex distribution of patients' by age

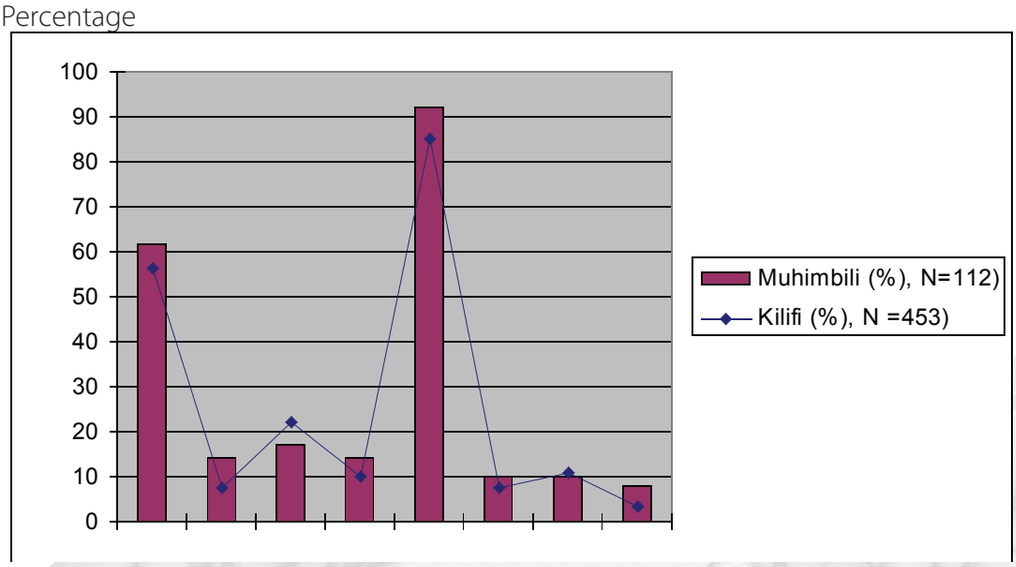
	Kilifi District Hospital		Muhimbili Hospital	National	Proportion of patients in age
Age in months	M (%)	F (%)	M (%)	F (%)	
0-12	53	46	61	50	50
13-24	17	20	20	18	19
25-36	13	11	11	12	12
37-48	8	9	5	12	9
>48	9	14	2	9	10
Total percentage	100	100	100	100	100

M=male F=female

The most common symptoms and indications for lumbar puncture are summarised in figure 1. Fever and convulsions were the most commonly reported symptoms.

Figure 1: Symptoms and signs in patients who had lumbar puncture performed at Muhimbili and

Kilifi Hospitals
Percentage



NB; child presented with one or more sign/symptom – e.g. convulsions, neck stiffness, and unconsciousness.

Important differences existed between the two hospitals with regard to indications for performing a LP. KDH has its own established criteria as indications for performing a LP, a protocol that is followed by attending clinicians. MNH uses the IMCI guidelines for signs and symptoms of CNS pathology to decide on the need of performing an LP. Convulsions and prostration were the most common indication for doing LP in both hospitals.

Table 2: The levels of CSF sugar and protein in patients at Kilifi and Muhimbili Hospitals

CSF parameters	Kilifi (%), N=453)	Muhimbili (%), N=112)
CSF WBC /mm^3		
<10	83.3	88.3
10 – 50*	8.9	6.7
>50**	7.1	5
CSF/Blood sugar ratio		
<0.1	15.0	***
0.1-0.67	45.7	***
>0.67	39.3	***
CSF protein g/L		
≤0.4	60.4	12.9
>0.4	39.6	87.1

Key: * Possible meningitis; **Probable meningitis; ***blood sugar levels not determined

Results of biochemical and cytological parameters are summarized in Table 2. There were few CSF samples collected for biochemical and cytological studies at MNH than at KDH. Analysis of CSF, protein and blood sugar levels were performed in all 453 patients at KDH. The mean CSF sugar was 3.1 (SD 1.6) mmol/L and the median was 3.0 mmol/L. In MNH, only CSF sugar level was performed in 86 of the 112 (77%) patients. Blood sugar levels were not determined at the time of the LP. Therefore CSF/blood sugar ratio was not calculated from MNH. The mean CSF sugar was 2.95 (SD 1.1)mmol/L and the median was 3.0mmol/L. At KDH, the majority showed normal protein levels with a mean CSF protein of 0.66 (SD 0.40) g/L and a median of 0.3 g/L. The majority of patients from MNH had abnormal CSF protein (87.1 versus 39.6%) compared to KDH. The MNH mean CSF protein was 1.79 (SD 1.1)g/L and the median was 1.5g/L. Bacterial isolates were rarely obtained on culture in both hospitals. Over 97% of the samples had no isolates (Table 3).

Table 3: Common organisms isolated from CSF samples at Kilifi and Muhimbili Hospitals

Organism	Kilifi		Muhimbili	
	<2months	>2months	<2months	>2months
Acinetobacter	1	0	0	0
Bacillus spp	1	0	0	1
Beta haemolytic streptococcus	1	0	0	0
Salmonella spp	0	2	0	0
Streptococcus pneumoniae	2	4	0	0
Streptococcus pyogenes	1	0	0	0
Escherichia coli	0	0	0	1
Haemophilus influenza	0	0	0	1
No growth	110	330	7	102
Total	116	336	7	105

There were differences in the isolates found in the two hospitals, with one Bacillus contaminant in both populations. Streptococcus pneumoniae and Salmonella species were the most common causes isolates in patients >2months at KDH. No pathogens were isolated in children <2 months at MNH.

Discussion

Our study has shown that only a few LPs are performed among children admitted to Muhimbili National Hospital in Tanzania as compared to Kilifi District Hospital in Kenya. The rate of LPs at Kilifi was seven-fold that at MNH. The availability of clear guidelines outlining the indications for

LP and a mechanism for strict adherence to the protocol at KDH ensures that children who need a lumbar puncture get it. Moreover, the automated data management system, as well as the well-established laboratory back up for microbiological studies at Kilifi means improved accuracy in data collection. However, at Muhimbili the method of data collection and incompleteness of records are likely to have contributed to the omission of some cases during data analysis. It is however important to note that most patients at MNH had abnormal CSF proteins suggesting that at least patients with overt features of meningitis get a lumbar puncture.

Suspected pyogenic meningitis was the main reason to perform a LP at the two hospitals. These findings are similar to those from other studies (Wiersinga et al., 2004). None of the study participants had LPs performed for the purposes of intra-thecal medication or anaesthesia. Although some differences were observed in the organisms isolated from CSF samples at the two hospitals, it is difficult to make any conclusions given the small numbers. However, a striking observation is the absence of H. influenzae at KDH and only one case at MNH, a finding that may reflect the effectiveness of the recently introduced Hib vaccines in the childhood immunisation schedule.

In over 97% of samples submitted for microbiological analysis, no organisms were isolated. It is possible that the absence of organisms on cerebrospinal fluid culture is due to pre-treatment with antibiotics (McCarron et al., 1996). On the other hand, it is possible that many of these cases are due to viral meningitis suggesting that such infections may be a common cause of meningitis in the study area. Prospective studies should be designed to establish this.

In a recent study at MNH Streptococcus pneumonia, C. neoformans and H. influenzae type B were the commonest isolates in children aged < 15 years with clinical meningitis (Matee & Matre, 2001). Similarly, S. pneumoniae and H. influenzae (41.9%) were the predominant isolates among children admitted with acute bacterial meningitis between 1994 and 2000 (Mwangi et al. 2002).

Performing lumbar puncture in children is one of the useful investigations procedure for detecting CNS infections or pathology. In some hospitals, LPs are rarely performed, mainly because of the low rate of isolation of bacterial pathogens even in patients with overt features of acute bacterial meningitis. This may be due prior antibiotic therapy or poor handling of CSF specimens including delays in processing specimens. In addition, lack of proper guidelines and delays associated with waiting for LP results have contributed against its utility in guiding treatment.

In other hospitals the procedure is carried out helping to differentiate bacterial meningitis from other differential diagnoses among children who present with febrile seizures, neck stiffness, unconsciousness, symptoms and signs of complex seizures (Laditan, 1995; Berkkey et al., 2004). Sometimes presumptive treatment with antibiotics and antimalarials targeting suspected bacterial meningitis and cerebral malaria is initiated before performing LP. Such a practice avoids delays in initiating life-saving treatment and thus complications of cerebral malaria or bacterial meningitis. In a study conducted on indicators of acute

bacterial meningitis in children at a rural Kenyan district, 2.0% of all admissions had the disease which was the most common indication for a LP. In this study, independent predictors form ABM were a bulging fontanelle, neck stiffness, cyanosis, impaired consciousness, partial seizures, and seizures outside the febrile convulsions age range (Kanegaye et al., 2001).

The sterilization of CSF with antibiotic pre-treatment may influence the yield from CSF and may complicate decisions on whether to continue with treatment or not. Failure to perform LPs may result in unwarranted prolonged treatment with antibiotics if the clinical presentation and other laboratory findings cannot exclude ABM.

In conclusion, lumbar punctures are performed less frequently at Muhimbili than Kilifi Hospital. Pneumoccocus and Salmonella species are the commonest causes of pyogenic meningitis. It is recommended that strategies should be put in place to improve the rates of lumbar puncture in the two hospitals and the isolation of bacterial pathogens from cerebrospinal fluid cultures. Development of clear guidelines/ protocols for lumbar punctures may be useful. Such protocols should be audited regularly.

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