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Prevalence of Bacterial Meningitis in Pediatric Patients and Antibiotic Sensitivity Pattern at Komfo Anokye Teaching Hospital, Kumasi.

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ABSTRACT

The study aimed at investigating the prevalence of bacterial meningitis in pediatric patients and antibiotic sensitivity pattern at KATH, which serves as a referral center for Northern Ghana.A retrospective study of CSF samples of pediatric patients between the ages of 0 to 12 years from 2008 to 2011 were used for this study. From the CSF samples from suspected meningitis pediatric patients, six (6) were confirmed bacterial meningitis. Out of the six (6) bacterial meningitis confirmed. *Streptococcus pneumonia* (71.03%) was the leading cause of bacterial meningitis in pediatric patients. There were some few cases of *Neisseria meningitidis* (3.74%), *Haemophilus influenzae* (1.87%) and other bacteria (23.36%) that were also contributing to these cases of bacterial meningitis.Cetriaxone (97.57 %) was sensitive to all bacterial meningitis followed by Chloramphenicol (64.71%) sensitive to all bacterial meningitis except Pseudomonas spp and Ceftaxime (59.57%) sensitive to *Streptococcus pneumonia, Neisseria meningitidis and Salmonella.* Penincillin (36.57%) was sensitive to only *Streptococcus pneumonia and Neisseria meningitidis*. Ampicillin, Ceftazidime and Cotrimoxazole were not sensitive to all the bacterial meningitis.

Keywords: Bacterial meningitis, Komfo Anokye Teaching Hospital (KATH); CerebrospinalMeningitis, (CSM), cerebro spinal fluid (CSF)

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INTRODUCTION

Meningitis is an inflammation of the membranes that cover the brain and spinal cord, known collectively as the meninges (Sáez-Llorens and McCracken, 2003). People sometimes refer to it as spinal meningitis, meningococcal meningitis, cerebrospinal meningitis, (CSM). Meningitis can be caused by a viral, bacterial, parasitic infection and rarely by certain drugs (Ginsberg, 2004). Knowing the cause of meningitis (by a virus, bacterium, parasite or drug) is important because the severity of illness and the treatment differ depending on the cause. Viral meningitis is generally less severe and clears up without specific treatments. But bacterial meningitis can be quite severe and may result in brain damage, hearing loss, or learning disabilities. The bacteria which cause cerebrospinal meningitis are a normal commensally of the nasopharyngeal cavity. The disease is contagious but not as highly contagious as the common cold. One can be infected if one touches or comes into contact with respiratory droplets from infected person. The types of bacteria that cause bacterial meningitis vary by age group. In premature babies and newborns up to three months old, common causes are group B streptococci (subtypes III which normally inhabit the vagina and are mainly a cause during the first week of life) and those that normally inhabit the digestive tract such as *Escherichia coli* (carrying K1 antigen). *Listeria monocytogenes* (serotype IVb) may affect the newborn and occurs in epidemics. Older children are more commonly affected by *Neisseria meningitides* (meningococcus), *Streptococcus pneumoniae* (serotypes 6, 9, 14, 18 and 23) and those under five by *Haemophilus influenzae* type B.(Sáez-Llorens and McCracken, 2003; Tunkel *et al*., 2004). In adults, *N. meningitides* and *S. pneumonia* together cause 80% of all cases of bacterial meningitis, with increased risk of *L. monocytogenes* in those over 50 years old (Tunkel *et al*., 2004, van de Beek *et al*., 2006).

Bacterial meningitis is now among the top 10 infectious causes of death worldwide (Grimwood *et al*., 2000). The highest disease rates of meningococcal meningitis are found in children 10-19 years (Hodgson *et al*., 2001). During epidemics, the harmattan season (from December to March) older children, teenagers and young adults are also affected. The incubation period is 2-10 days, often 3 days. Most of the infections are sub clinical with many infected people becoming carriers without symptoms. Signs and symptoms in infants can be particularly subtle. They may have only a fever or be hypothermic or even a febrile. They may not have a stiffneck. The chief complaint of an infant who has meningitis is often nonspecific and includes: irritability, lethargy, poor feeding, fever, seizures, apnea, a rash, or a bulging fontanelle (Martin *et al*., 2006). High fever, headache, and stiff neck are common symptoms of meningitis in anyone over the age of 2 years. These symptoms can develop over several hours, or they may take 1 to 2 days. Other symptoms may include nausea, vomiting, discomfort looking into bright lights, confusion, and sleepiness.

In newborns and small infants, the classic symptoms of fever, headache, and neck stiffness may be absent or difficult to detect. Infants with meningitis may appear slow or inactive, have vomiting, be irritable, or be feeding poorly. As the disease progresses, patients of any age may have seizures. Since the pneumococcal vaccine was introduced, however, rates of pneumococcal meningitis have declined in children and adults (Hsu *et al*., 2009)

MATERIALS AND METHODS

The study area was the Komfo Anokye Teaching Hospital (KATH) located in Kumasi, the capital of Ashanti Region with a total projected population of 4,839,100(Ghana Statistical Service, 2010). Kumasi lies in the central forest belt of Ghana, situated at 6.72^{o}N 1.60^{o}W, approximately 290 m above sea level and approximately 200km inland from Atlantic coast and can also be located near Lake Bosomtwe, in the Rain Forest Region about 250 kilometres (160 mi) (by road) northwest of Accra. Kumasi is approximately 300 miles (480 km) north of the Equator and 100 miles (160 km) north of the Gulf of Guinea, with a population of 1,517,000, Kumasi is the second-largest city in the country. The teaching hospital apart from taking care of patients located in the Ashanti region, it also attends to referral cases from the Northern, Upper East, Upper West and Brong Ahafo Regions of Ghana which are prone to Meningitis. (Ghana Statistical Service, 2011).

The laboratory records of all pediatric patients suspected of bacterial meningitis who underwent a lumbar puncture were retrospectively reviewed from January 1, 2008 to December 31, 2011. Data were retrieved from laboratory record books and double entered unto SAS JMP. Demographic data, clinical diagnoses, isolated organisms, cerebrospinal fluid (CSM) appearance and antibiotic susceptibility profile of organisms were collected. Any sample received from a patient who had a second sample submitted within 3 weeks of the first sample was counted as a single positive case. All coagulase negative staphylococci with cell counts less than 10cells/mm^3 were regarded as contaminants. Cases collected from the laboratory records were classified into probable and confirmed meningitis. Probable bacterial meningitis was defined as a case with no bacteria identified in the CSF and with leukocytosis (≥100 white blood cell/mm^3 with > 60% neutrophils) (WHO 2004, 2011, Fishman 1992). Confirmed case of meningitis was defined by one of the following: 1) bacterial or cryptococcal isolation from CSF culture, 2) A positive Gram Stain with no bacterial growth (WHO 2005, 2011).

The samples from suspected cerebrospinal meningitis pediatric patients were used for this research. The physical appearance of the cerebro spinal fluids samples of the patients were determined-(clear, slightly turbid, cloudy, purulent, bloody or clotted) by the unaided eye in front of light source. The fastidious and non-fastidious bacteria were determined by culturing on chocolate agar immediately to prevent contamination and incubated under micro-aerophilic (carbon dioxide rich) condition at 37^{o}C for up to 48hrs and cultures were examined for the growths. The pus cells and pathogens present were determined using a wet preparation of the sample and pus cell were counted using the Neubauer Counting Chamber. Polymorphs indicated bacterial infection whiles lymphocytes indicated viral or tuberculosis meningitis. A direct Gram stain was performed to identify any pathogen present. A latex agglutination test to identify any pathogen through antibody-antigen reaction was done by centrifuging the sample for 5 minutes and the supernatant was used. Biochemical characterization of the isolates were done according to (MacFaddin, 2000; Cheesbrough, 2006). Antimicrobial susceptibility test (Kirby-Bauer Method) was done according to (Cheesbrough, 2006) The positive patients (patients from which isolates has been successful) were followed-up to know and record the antibiotic given, the dosage and the rate of recovery.

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RESULTS

TABLE 1: NUMBER OF PATIENTS WITH CSF IN THE YEAR 2008 TO 2011

Months	YEAR 2008			YEAR 2009			YEAR 2010			YEAR 2011		
	No of cases	Confirmed bacterial meningitis	Probable Bacterial Meningitis	No of cases	Confirmed bacterial meningitis	Probable Bacterial Meningitis	No of cases	Confirmed bacterial meningitis	Probable Bacterial Meningitis	No of cases	Confirmed bacterial meningitis	Probable Bacterial Meningitis
JAN	65	2	4	100	3	6	85	2	5	94	3	6
FEB	46	1	3	121	3	8	93	3	6	79	2	5
MARCH	73	2	4	90	2	5	79	2	4	89	2	4
APRIL	103	3	6	106	2	7	98	3	7	89	2	4
MAY	75	1	5	98	3	6	83	4	6	85	2	5
JUNE	101	4	7	90	2	7	92	2	5	100	4	3
JULY	109	2	6	98	2	8	107	3	8	82	2	5
AUG	81	2	5	77	1	9	75	2	3	95	4	6
SEPT	77	3	5	71	3	5	74	1	6	89	2	5
OCT	69	1	4	72	2	4	65	2	4	33	1	2
NOV	79	1	4	94	4	6	87	1	5	20	1	9
DEC	73	2	6	94	3	7	85	2	3	60	0	4
TOTAL	951	24	59	1111	30	78	1023	27	62	915	26	51

Source: KATH Microbiology Laboratory records books.

TABLE 2 : PREVALENT OF BACTERIA PATHOGEN ISOLATED FROM 2008 – 2011

Meningitis pathogens	YEAR 2008		YEAR 2009		YEAR 2010		YEAR 2011	
	No of Isolates	% of Isolates	No of Isolates	% of Isolates	No of Isolates	% of Isolates	No of Isolates	% of Isolates
E. coli	1	4.17	1	3.33	1	3.70	1	3.85
H. influenza	0	0/00	0	0.00	1	3.70	1	3.85
N. meningitidis	1	4.17	1	3.33	1	3.70	1	3.85
Others/Coliform	2	8.33	4	13.33	2	7.41	1	3.85
Pseudomonas spp	1	4.17	2	6.67	1	3.70	1	3.85
S. pneumonia	17	70.83	20	66.67	19	70.37	20	76.96
Salomonella spp	2	8.33	2	6.67	2	7.41	1	3.85
Total	24	100	30	100	27	100	26	100

Source: KATH Microbiology Laboratory records books

TABLE 3: MENINGITIS PATHOGENS AND AGE GROUP OF INFECTION (2008-2011)

MENINGITIS PATHOGENS	< 1 MONTH	1 MONTH - < 5 YEARS	5 YEARS TO 12 YEARS	TOTAL
E. coli	2	2	0	4
H. influenza	0	2	0	2
N. meningitidis	2	0	2	4
Others/Coliform	3	4	2	9
Pseudomonas spp	3	2	0	5
S. pneumonia	14	34	28	76
Salmonella spp	2	5	0	7
Total	26	49	32	107

Source: KATH Microbiology Laboratory records book

TABLE 4: COMPARISON OF BACTERIAL MENINGITIS CASES FROM 2008 TO 2011

CASES	YEARS				TOTAL
	2008	2009	2010	2011	
Number of cases	951	1,111	1,023	915	4,000
Confirmed Bacterial Meningitis	24	30	27	26	107
Probable Bacterial Meningitis	59	78	62	51	250

Source: KATH Microbiology records books

TABLE 5: COMPARISON OF BACTERIA ISOLATES FROM 2008 TO 2011

MENINGITIS PATHOGENS	NUMBER OF ISOLATES				TOTAL
	2008	2009	2010	2011	
E. coli	1	1	1	1	4
H. influenza	0	0	1	1	2
N. meningitidis	1	1	1	1	4
Others/Coliform	2	4	2	1	9
Pseudomonas spp	1	2	1	1	5
S. pneumonia	17	20	19	20	76
Salomonella spp	2	2	2	1	7

Source: KATH Microbiology records books

DISCUSSION OF RESULTS

From the retrospective study of CSF samples at KATH from the year 2008 to 2011, the prevalence of confirmed meningitis was 2.68% and probable meningitis was 6.25% out of 4,000 pediatric patient's samples. This low prevalence could be attributed primarily to the use of antibiotics and pneumococcal vaccines to protect individuals before admission. This was in accordance to the reports of Kilpatrick *et al*., (1987); Sacchi *et al*., (2011). The results showed a consistent reduction meningitis cases from 2008 to 2011. This reduction could be as a result of increase in preventive public health interventions. The most prevalent bacteria which causes meningitis was *Streptococcus pneumoniae* 4 (66.67%) occurring mostly among pediatric patients. The auto-transmission of this pathogen from the nasopharynx into the meninges is therefore highly possible especially during the dry season when crack and injuries tend to occur in the nasopharynx. Countries which have introduced pneumococcal conjugate vaccines have reported a reduction in the cases of pneumococcal meningitis (Cutts *et al*., 2005).

The four cases of *Neisseria meningitides* and two case of *Haemophilus influenzae* over the four year period may be due to vaccination against Hib given to the children at birth which is expected to protect children against *Haemophilus influenzae* infection. It is however possible that those affected children may not have been vaccinated against *Haemophilus influenzae*. This is possible especially in children who might have been borne in rural areas where access to healthcare and vaccination may be difficult. The low prevalence of *Neisseria meningitidis* could be attributed to the low sensitivity of the culture technique employed. All isolates identified during the study period were tested against Penicillin, Ceftriaxone, Cefotaxime, Chloramphenicol, Ceftazidime, Septrin, Gentamycin, Amikacin and Ampicillin. All isolates were 100% susceptible to Ceftriaxone with the exception of isolates

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TABLE 6: ANTIBIOTIC SENSITIVITY PATTERN AGAINST ISOLATED PATHOGENS FROM 2008 TO 2011

ANTIBIOTICS	MENINGITIS PATHOGENS					OVERALL PERCENTAGE (%)	Overall Percentage (%)		
	S. pneumoniae	*N. meningitidis*	*H. influenza*	*Salmonella spp*	*Pseudomonas spp*		E. coli	Others	Sum
Amikacin	NA	NA	NA	2/2 (100%)	1/2 (50%)	50.00	3/3 (100%)	3/3 (100%)	50
Ampicillin	NA	NA	0/1 (0%)	0/3 (0%)	NA	2.00	0/4 (0%)	1/7 (14%)	2
Cefotaxime	16/16 (100%)	2/2 (100%)	NA	3/3 (100%)	NA	59.57	2/3 (67%)	2/4 (50%)	59.57
Ceftazidime	NA	NA	NA	0/1 (0%)	0/2 (0%)	0.00	NA	NA	0
Ceftriaxone	76/76 (100%)	2/2 (100%)	1/1 (100%)	3/3 (100%)	2/2 (100%)	97.57	3/3 (100%)	5/6 (83%)	97.57
Chloramphenicol	63/76 (83%)	2/2 (100%)	1/1 (100%)	1/4 (25%)	NA	64.71	2/3 (67%)	7/9 (78%)	64.71
Cotrimoxazole	NA	NA	NA	0/4 (0%)	NA	2.00	0/3 (0%)	1/7 (14%)	2
Gentamicin	NA	NA	NA	2/2 (100%)	1/2 (50%)	37.14	1/2 (50%)	3/5 (60%)	37.14
Penincillin	75/76 (99%)	3/3 (100%)	0/1 (0%)	NA	NA	36.57	NA	4/7 (57%)	36.57

Source: KATH Microbiology Laboratory records book

ABBREVIATIONS

BD - BECTON DICKINSON
KATH - KOMFO ANOKYE TEACHING HOSPITAL
CSF - CEREBROSPINAL FLUID
SAS - A PART OF JMP
JMP - STATISTICAL SOFTWARE
CSM - CEREBROSPINAL MENINGITIS
WHO - WORLD HEALTH ORGANIZATION
TSI - TRIPLE SUGER IRON
NCCLS - NATIONAL COMMITTER FOR CLINICAL LABORATORY STANDARD
NBG - NO BACTERIAL GROUP AFTER 48 HOURS OF INCUBATION
RBC - RED BLOOD CELLS
GNDC - GRAM NEGATIVE DIPLOCOCCI
GPDC - GRAM POSITIVE DIPLOCOCCI
NOS - NO ORGANISM SEEN
NA - NOT APPLICABLE
PCR - POLYMERASE CHAIN REACTION
Hib - HAEMOPHILUS INFLUENZA TYPE B
D&T C - DRUGS AND THERAPEUTIC COMMITTEE
E. COLI - ESCHERICHIA COLI
WBC - WHITE BLOOD CELLS

classified as "other/coliform" giving it overall percentage of 97.57%, followed by Chloramphenicol (64.71%) and Cefotaxime (59.57%) in that order. Penincillin had an overall percentage of 36.57% but was however very sensitive to *S. pneumonia* and *N. meningitidis*. Conclusively *Streptococcus pneumoniae* still remains a major cause of bacterial meningitis among children. Ceftriaxone can still be considered as the best choice for treating meningitis patients.

It is recommended that Mothers should give their children good nutrition to boast their immune system especially the six months exclusive breast feeding method for their babies to ensure enough immunoglobulin to build up and boast the immune system.

People should take the habit of drinking at least 8 glasses of water especially during the dry seasons to prevent injuries at the nasopharyngeal cavity where *S. pnuemoniae*, *N meningitidis* and *Haemophilus influenzae* are normal commensals.

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