Bacterial Meningitis in India

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INTRODUCTION

Meningitis is an infection of the membranes or meninges that surround the brain and spinal cord. (Harms, 2013) A virus causes most of the cases of meningitis, but fungi and bacteria can also be possible causes. Dependent upon the source of the infection, meningitis can heal on its own within a few weeks or it can turn into a deadly infection that requires urgent treatment with strong antibiotics. (Harms, 2013)

Early symptoms of meningitis can easily be mistaken for the flu. Symptoms may develop over a span of a few hours or over a couple of days. Some symptoms include: Sudden High Fever, Severe Headache, Stiff Neck, Vomiting and Nausea, Confusion or Difficulty concentrating, Seizures, Sleepiness, Sensitivity to light. Viral meningitis may get better on its own, but bacterial meningitis is very serious. (Harms, 2013) Bacterial meningitis can be fatal within days

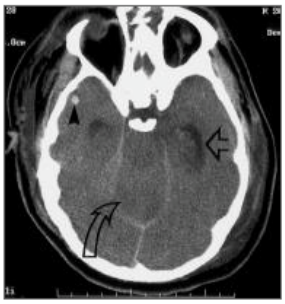
Focusing more on bacterial meningitis, there are several strains of bacteria that cause meningitis. The most common ones are: Streptococcus Pneumoniae, Neisseria Meningitidis and Haemophilus Influenzae. These 3 strains of bacteria are all respiratory pathogens. They can colonize the mucosa of the nasopharynx and oropharynx when acquired by a person. From there, they are able to cross the mucose and enter the blood. Once the bacteria enter the bloodstream, they can reach the meninges and cause meningitis.

Streptococcus Pneumoniae is an encapsulated bacterium. Numerous S. Pneumoniae serotypes are capable of causing invasive disease, such as meningitis and pneumonia. Meningitis caused by a strain of S. Pneumoniae are more common in very young children and very old adults. Its estimated incidence rate is 17 cases per 100,000 children less than 5 years old. Its fatality rate in children younger than 5 years old exceeds 73% in some parts of the world.

Neisseria Meningitidis is a bacterium that is either encapsulated or unencapsulated. However, most of all invasive N. Meningitidis strains are encapsulated or surrounded by a polysaccharide capsule. Incidence rates for meningitis caused by this bacterium are generally highest in children younger than five years old and adolescents. This bacterium can also caused meningococcemia, a severe bacteremia.

Lastly, Haemophilus influenzae is a bacterium that can be either encapsulated or unencapsulated. This bacterium is sub-categorized into six different serotypes; a, b, c, d, e and f with H. infulenzae type b (Hib) being the most common cause of invasive disease. Rates of meningitis due to this particular bacterium are

highest in children younger than 5 years old. For children less than 5 years old, the fatality rate of meningitis due to H. influenzae is higher than that of meningitis caused by N. meningitidis.



Head CT demonstrates enlargement of the temporal horns indicating increased intracranial pressure (horizontal open large arrow). The closed arrowhead shows small intracerebral hemorrhage foci on the right temporal lobe, and the curved arrow shows the effect of increased intracranial pressure on the cerebellum.

METHODOLOGY

There are several methods for testing for the cause of meningitis in a person. Blood cultures, Imaging, and Spinal taps are the most common ways to test which variety of meningitis is causing an infection. The most definitive way of testing for meningitis is through the spinal tap. Cerebrospinal fluid (CSF) is drawn from the spine and analyzed in a lab. When people have meningitis the Cerebrospinal Fluid will show low glucose level with an increased count of white blood cell and protein. A spinal tap will also help the doctor identify the exact bacteria that caused it. This will greatly help in determining which treatment should be performed on the patient.

OVERVIEW OF MENINGITIS IN INDIA

Meningitis has a long history of outbreaks in India. With India being one of the lower income countries in the world, most of their population lives in poverty (Sinclair, 2010). With the rate of poverty at such a high rate and the population densely packed in urban areas, disease will spread quickly.

In 2005 there was an outbreak of meningitis in Delhi, India where 111 cases were reported (Sinclair, 2010). Of those 111, 15 died. Before then two more major outbreaks of meningitis were reported in India; one in 1966 and one in 1985. In 1966, 616 cases were reported with a fatality rate of 20.9% (Sinclair, 2010). The outbreak in 1985 was far worse than the one that happened in 1966. In the 1985 Meningitis outbreak, 6133 cases were reported with 799 deaths. (Sinclair,2010) This is just in one city. Meningitis isn't the only disease that is prevalent in India. As

the chart below shows, Meningitis only accounts for no more than 2.6% of total admissions in different care centers. Even still, meningitis is a big problem mainly because of its prevalence in children and newborns.

Table 1. Admissions for Cases of Bacterial Meningitis in Different Centres

Place	No. of cases	Total admissions	Frequency (%)
Calcutta	28	3400	0.8
Jaipur	287	11134	2.6
Delhi (KSCH)	394	20307	1.9
Delhi (AIIMS)	48	3348	1.4
Calcutta	15	2904	0.5
Jodhpur	80	5245	1.1
Total	852	56338	1.5

As shown by the chart below streptococcus pneumoniae is the most common in children 3 months to 1 year old in India.

Table 2. Distribution of Patients According to Age and Causative Organisms Isolated

Organisms	0-3 mo	3 mo-1yr	1 yr-5 yr	5 yr-12 yr	Total
N. meningitidis	-	3	4	14	21
S. pneumoniae	1	10	3	8	22
H. influenzae	-	5	2	1	8

The poor healthcare system in India, especially in the low-income areas makes meningitis an even deadlier disease. Early detection is the key to being able to treat bacterial meningitis. Low- income citizens of India however, are reluctant to go see a doctor or go to a hospital because of lack of money and corrupt health systems. There are no government programs to adequately help provide health care for the children and the elderly. Most people don't see a doctor unless they feel very ill and in the case of having meningitis, it could prove deadly. According to a recent study done by the IMS Institute of Health Informatics in July 2013; that 72% of the rural Indian population has access to just 33% of the country's available hospital beds and that 28% of Indians living in urban areas have access to only 66% of total beds. The study also concluded that 63% people who live in remote areas have to travel more than 5 kilometers to access a basic in-patient facility. (Ali, 2014)

CASE STUDIES

The two cases presented deal with a one-year-old boy and a 41-year old female. Both subjects are from Delhi, India. The one-year-old boy was infected with Neisseria Meningitidis and the 41-year old woman was infected with Streptococcus pyogenes. Both developed symptoms of meningitis.

The first case deals with a young boy who is one year old. The young boy was admitted with high-grade fever, vomiting, lethargy and decreased oral acceptance for three days. He had "many episodes of generalized tonic clonic seizures in the last 24 hours." During examinations, doctors found that the child was conscious, had no cyanosis (blue or purplish coloration of the skin) and had bilaterally constricted pupils with sluggish reaction to the light. He had a fever of 101°F had a heart rate of 172 beats per minute. Neck rigidity was present. There was increased tone in all four of his limbs. An initial clinical diagnosis of meningitis was made and he was started on intravenous ceftriaxone and anticonvulsants. A spinal tap was performed and the laboratory results showed that his protein levels were elevated (113mg/dL) and his glucose levels were low (26mg/dL). Further analysis of the CSF confirmed that the cause of the meningitis was N.Meningitidis serogroup B. This strain is resistant to penicillin and ciprofloxacin. Other antibiotics such as ceftriaxone, azithromycin and rifampicin must be use to kill this strain of bacteria. The patient continued to receive intravenous ceftriaxone and was put on a ventilator machine because of repeated seizures and declining oxygen saturation. After 7 days, the patient started showing some improvements; the seizures had stopped and blood cultures showed no growth of the bacteria. After 16 days of continuous antibiotic therapy, a repeat spinal tap showed that the CSF examination was within normal limits. Despite this, the antibiotic treatment was continued for 5 more days. The child recovered after 29 days of being admitted and was discharged from the hospital.

The second case deals with a middle-aged woman who is 41 years old. She was admitted with a fever, headache, vomiting and sore throat. A week earlier, she was seen at another local hospital with a fever and vomiting, and was diagnosed with acute pharyngitis. She was given azithromycin. During her current admission she had a 101°F fever and her heart rate was 96 beats/minute. Neck rigidity was present, but her respiratory system, cardiovascular system and abdomen were all normal. Because of her history of symptoms it was suspected that she had bacterial

meningitis and a spinal tap was performed. Because of her rapidly deteriorating condition, she was transferred to the intensive care unit. In the ICU, she was put on a breathing machine. Her pupils were tested and they appeared to be equal but weakly reactive to light. The analysis of her CSF showed that her glucose levels were within normal limits (61mg/dL) but her proteins were elevated (474mg/dL). She was initially treated with ceftriaxone. The CSF culture grew a strain of S.pyogenes that were sensitive to penicillin, ceftriaxone and vancomycin. After the third day, vancomycin was added to her treatment, but her condition continued to deteriorate and she died on the fourth day. There are speculations that could be made regarding the quality of care each patient received, but the case studies didn't show any evidence of inequality with the healthcare received by each patient.

ANALYSIS

In the cases presented above, it was clear that the patient infected with the S.pyogenes was the more severe of the two cases. S.pyogenes isn't a strain of bacteria that typically causes meningitis and only about 0.2% to 0.6% of all meningitis cases are caused by it. The tests also show how the S.pyogenes bacterium was more potent than the N. Meningitidis. The woman's protein levels were almost 4 times as much as the baby's protein levels. That indicates that there is an increased presence of replicating bacteria, which have a composition of protein. The two patients also had some differences in their symptoms. The one year-old child exhibited seizures and cyanosis, while the 41 year-old woman exhibited early symptoms similar to a throat infection. It can be seen that the specific strain of S.pyogenes that the woman had was more aggressive in replicating compared to the one that infected the child. The bacteria was able to take over her body and kill her within four days, even after receiving vancomycin, which is one of the strongest antibiotics available at this time. Even with the big gap in age, the one year-old boy was still expected to have to more vulnerable immune system compared to the 41 year-old woman who was previously healthy before being infected with S.pyogenes. There are speculations that could be made regarding the quality of care each patient received, but the case studies didn't show any evidence of inequality with the healthcare received by each patient.

VACCINES

Vaccines for meningitis have been developed. In 1978 a vaccine called, meningococcal polysaccharide vaccine, or MPSV4 was approved. It consists of

antigens from the outer polysaccharide capsule that surround the bacterium. A newer version of the vaccine rolled of the laboratory in 2005. It is called the meningococcal conjugate vaccine, or MCV4. This newer vaccine takes antigens from the polysaccharide and is bound to a separate protein that targets the body's immune system. This newer vaccine makes it easier for the body's immune system to recognize the antigens. There are two types of MCV4 vaccines; Menveo and Menactra. Menveo has been approved to be used in people aged 2 to 55 and Menactra has been approved for people 9 months to 55 years old. These vaccines however only protect against the four strains of meningococcal meningitis caused by Nisseria Meningitidis. It does not protect against the other strains of bacteria that causes meningitis. A problem in India is access to these vaccines. With the lack of access to local healthcare facilities, low-income citizens usually don't have access to vaccines such as these.

CONCLUSION

As shown by the two cases presented above, meningitis can be an extremely dangerous disease. There are some factors within the health system in India that can be improved in order to be able to control this disease and prevent future outbreaks. Access to adequate medical care is key to be able to catch this disease in its early stages and prevent what could be a potentially fatal result. Vaccines have been developed to hopefully increase prevention of contracting the disease. The vaccines however, do not cover all strains of meningitis. It is still important to have good hygiene to prevent the spread of bacteria. With some improvement in the healthcare system of India, the death rate of meningitis should begin to decline.

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