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Case Report: Recurrent Bacterial Meningitis in a Child with Structural Defect of the Base of the Skull- A Rare Presentation

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Abstract **Case Report**

Recurrent bacterial meningitis (RBM) in children is unusual. It is usually associated with a predisposing factor, such as immunological deficiencies or anatomical defects. About 1.3% of children with bacterial meningitis had experienced at least one previous episode. Anatomical defects are the most common risk factor for RBM. An accurate diagnosis of the underlying pathology is crucial for preventing the further recurrence of bacterial meningitis.

Case Report: We report a case of RBM in a 5-year-old female with a history of fever, projectile vomiting, neck stiffness, and seizures. There is a history of 3 admissions in the past, with the same history of clear nasal discharge, which usually precedes neck stiffness and seizures. A cranial CT scan showed a basal skull defect. She was co-managed with the ENT and neurosurgeon.

Conclusion: Recurrent bacterial meningitis, though infrequently encountered, poses a major diagnostic challenge. This case report contributes significant clinical insight into the presentation and management of a rare presentation in a low-resource tertiary healthcare setting. Its importance lies in highlighting diagnostic challenges and treatment approaches in the context of limited diagnostic infrastructure.

Keywords: Recurrent Bacterial Meningitis (RBM), Parameningeal, Cerebrospinal Fluid (CSF), Basal Skull defect.

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INTRODUCTION

Recurrent bacterial meningitis is characterized by two or more episodes of bacterial meningitis that occur at least three weeks apart from the end of treatment for the first episode, or at any time if the infection was transmitted by a different organism.[1] The subsequent episode is considered a relapse or recrudescence if it occurs within three weeks and is brought on by the same bacterial organism.[2] This definition should not include cases with tuberculous meningitis, chronic meningitis, or the presence of foreign structures such as a ventriculo-peritoneal shunt or cochlea implant.[3] Up to 6% of patients who initially presented with community-acquired meningitis went on to experience a recurrence, according to a comprehensive retrospective research conducted by Durand et al.[4]

In adults, Adrani et al reported a comparable percentage of 5%.[5] However, in children, this percentage can be much smaller. While Lee et al identified a 5% recurrence, Drummond et al reported that only 1.3% of children with bacterial meningitis had bacterial meningitis at least once before. [6] Congenital and acquired causes can be used to broadly group the risk factors for RBM and can be further divided into immunological deficiencies, chronic para-meningeal infections, and anatomical abnormalities.[1] The migration of germs to the cerebrospinal fluid (CSF) spaces is facilitated by a variety of cranio-spinal abnormalities. Alternatively, immunological deficiencies that render the host defenses insufficient barriers against certain bacterial pathogens may accelerate the typical hematogenous spread.[7]

Between 1998 and 2007, 144 articles documented 363 cases of RBM. Anatomical factors accounted for 214 (59%) of RBM, while immunodeficiencies 132 (36%), and parameningeal infections 17 (5%) accounted for the remaining causes of RBM. Only 15 papers described five or more individuals with RBM, whereas the majority of publications (105 reports, or 73%) reported a single patient with RBM. A slight male

predominance (1.2:1) was observed.[1] In terms of structural issues, lumbosacral anomalies accounted for just 7% (16 cases), while cranial/cervical defects accounted for 93% (198 cases). Secondary CSF fistula from traumatic head injury accounted for nearly half of the cases in this group. Among patients with parameningeal infections, complement deficiencies accounted for the majority of cases (72 cases,55%), while chronic otitis media and/or chronic mastoiditis accounted for the remaining cases of RBM (11 cases, or 73%).[3]

Notwithstanding its rarity, RBM poses a significant diagnostic obstacle. To stop more episodes, it is still essential to determine the underlying cause of RBM. [1, 3, 8] RBM is managed by an interdisciplinary team that includes pediatricians, microbiologists, otolaryngologists (ENT surgeons), and neurosurgeons. A comprehensive evaluation starts with a thorough history and evaluation.

To isolate the aetiologic pathogen, lumbar puncture for cerebrospinal fluid analysis is required. Computed tomography (CT) scans of the cranium, paranasal sinuses, and temporal bone should be included in the imaging studies for RBM. It is also necessary to obtain multiple coronal views because axial views may not identify small defects. [6,10,11] To identify the precise location of CSF leakage, the brain computed tomography (CT) and CT cisternography are the gold standard investigations.[15] Additionally, in individuals with no active CSF leakage, brain MRI imaging can be used to identify CSF leakage or herniated tissue. [16] The underlying etiology determines the course of treatment; however, intravenous antibiotics are usually commenced promptly. The fatality rates for RBM and acute bacterial meningitis are reported as 0-15% and 20-30% respectively. [4,5]

Increasing knowledge among caregivers and quick health-seeking behaviors may be linked to lower mortality rates in RBM.[1,5] An otolaryngologist and audiologic evaluation are necessary to detect unidentified hearing impairment or hearing deficits which may be linked to inner ear deformity [1] This paper aims to raise awareness of RBM and its diagnostic difficulties, stressing the need for a high index of suspicion in enabling a timely diagnosis and averting future recurrences.

CASE REPORT

A 6-year-old female presented with complaints of fever and vomiting of 12 hours duration, neck stiffness of 8 hours duration, and watery nasal discharge seen on admission.

Her body was described as very hot, with several episodes of non-bloody, non-bilious, projectile vomiting. About 4 hours after the onset of vomiting, she developed neck stiffness, with associated generalized body weakness. At presentation, she had clear colored nasal discharge from the nostrils, which occurred occasionally and was regarded as catarrh, and this usually preceded the neck stiffness and seizures on each episode. There was no history of cough, headache, photophobia, seizures, loss of consciousness, or head trauma before the episode. She has not been on immunosuppressive drugs and has no history suggestive of malignancy before illness.

She has had 3 admissions in the last 4 years based on similar complaints. The first was at 1 year of age, and she was managed at a private hospital for 1 week and discharged. The second admission was when she was four years old. She also had several episodes of convulsions with loss of consciousness. At that time, she was managed for 4weeks and discharged home. The third admission was at 5years of age, and she was managed for 3weeks based on similar history, and subsequently discharged. Her hemoglobin genotype was AA, and there was no history suggestive of chronic illness. She had a successful cleft lip repair at 3months of life. Immunization was up to date for age according to the National Programme for Immunization schedule; however, no booster doses were given. She attained developmental milestones appropriately and could speaks simple sentences at the time of review. She could also dress herself correctly, draw and paint pictures.

On examination, she was ill-looking, febrile, with a healed surgical scar in the upper lip, not pale, not jaundiced, no lymphadenopathy, cyanosis, dehydration, or peripheral edema. Pulse Rate- 130bpm, Respiratory Rate-40cpm, Blood Pressure-110/60mmHg, Temperature- 38^0 C. There was nuchal rigidity, and other signs of meningeal irritation were present. There was no cranial nerve defect or focal neurological deficit. Other systemic examinations were normal. Full blood count done was suggestive of sepsis. Brain CT scan showed a defect in the base of the skull with herniation of the third ventricle into the nasal cavity, and presence of communicating hydrocephalus. However, attempts at lumbar puncture were unsuccessful.

Patient was managed with intravenous antibiotics for 14days and subsequently discharged to be followed up by the Neurosurgeon following a corrective surgery and ENT surgeons for audiological assessment. She is being followed up in our clinic and is doing well.

DISCUSSION

The morbidity and mortality rates of bacterial meningitis are high, making it a potentially fatal illness. About 1% of those with bacterial meningitis develop RBM, making it an uncommon occurrence.[11] Although the exact frequency of RBM has not been determined, some retrospective studies have proposed that up to 5–6% of patients may develop RBM. [4] Preventing subsequent episodes and enhancing the patient's overall outcome depend on an early diagnosis of the underlying cause.[1,12]

Despite research showing a modest male preponderance in RBM, our index case was female. The most frequent risk factor for recurrent meningitis is anatomical defects, such as spinal malformations or anomalies in the anterior fossa or temporal bone. This is consistent with the skull anatomical defect observed in our index case.[9,13] These disorders are primarily caused by the communication between the subarachnoid space and the skin, nasopharynx, middle ear cavities, or paranasal sinuses. The communications with the middle ear cavity, nasopharynx, and paranasal sinuses can result from fracture of the petrous bone, cribriform plate, and paranasal sinuses respectively.[9] Due to the potential direct contact of bacteria in

these cavities, meningitis may recur often in these patients; this may also be the case in the index child. A thorough physical examination and a detailed history taking may help identify a CSF rhinorrhea.

According to the index patient's history, the mother had noticed that frequent bouts of clear-colored nasal discharge usually preceeded neck stiffness. Since CSF rhinorrhea can be mistaken for normal nasal discharge, CSF rhinorrhea can be difficult to diagnose in young children and infants and is often misdiagnosed. This may contribute to the delay in diagnosis. [17] Majority of the time, the most prevalent CSF rhinorrhea occurs unilaterally. Usually, there is a transparent nasal discharge that often gets worse on performing the Valsalva maneuver or leaning forward, but it was not possible to determine in our index case.[14] Three out of fourteen RBM patients in research by Tuygun et al experienced rhinorrhea, and all of these patients had surgery done to prevent CSF leakage. There was no history of trauma in our index case, yet 10%-20% of people develop RBM even though there may be spontaneous resolution of CSF leakage after trauma. [13] There has been evidence of a higher risk for RBM when there is CSF leakage, especially if it lasts longer than seven days.[19] To determine whether a surgical repair—which has a high success rate overall and low mortality and morbidity—is necessary in cases of developmental or traumatic anatomical abnormality present, the pediatrician must consult with a neurosurgeon or an otolaryngologist. For this child, a multidisciplinary approach was commenced at the time of diagnosis.[5]

The predisposing conditions for RBM must be identified through extensive diagnostic testing. Imaging tests such as CT, CT cisternography, and MR Cisternography should be performed. The best visualization of the brain soft tissue and parenchyma is through magnetic resonance imaging (MRI). Although our patient was unable to have a CT cisternography done, a conventional brain CT scan revealed a basal skull defect. The use of prophylactic antibiotics in those with basal skull defects and CSF fistulas is still debatable. According to a recently published review, whether or not there is evidence of CSF leakage, antibiotic prophylaxis was ineffective in preventing recurrence of meningitis in basal skull anomalies. Following treatment for our index case, antibiotics were stopped.[19] Additionally, timely identification and correction of the anatomical defect with dura closure guarantees a positive outcome for neurological development and prevents subsequent episodes of meningitis.[18] The neurosurgeon has corrected the defect, and she is being followed up by the otolaryngologist.

CONCLUSION

Recurrent bacterial meningitis is an uncommon condition in children that presents a diagnostic difficulty and requires a methodological approach to identify the underlying cause and risk factors. The most frequent risk factor for RBM is anatomical abnormalities. Even in children with a documented CSF leak, rhinorrhea is uncommon. A comprehensive examination, including proper neuroimaging and immune function investigations, should be performed on all children who have a history of recurrent meningitis.

Therefore, to enable timely diagnosis, management, and prevention of subsequent recurrences, doctors must have a high index of suspicion.

This article adds to the limited amount of information available worldwide on RBM, particularly in African populations, where there is still a dearth of literature on these instances.

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