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# **Meningitis and Hearing Loss in Children**

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2051

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Report Submitted to fulfill the requirements for Scientific Research Activity

Date of Submission: 12/3/ 2019

## **Abstract**

Identifying hearing loss in children with bacterial meningitis and early recovery can lessen the children's long-term educational and social difficulties. Children underwent repeated audiological assessment with the first tests, being performed within six hours of diagnosis. By using a combination of otoacoustic emissions, auditory brain stem responses, and tympanometry the differences between cochlear, neural, and conductive defects were distinguished. All cases of hearing loss were evident at the time of the first assessment. In both the permanent sensorineural and reversible impairments the cochlea was identified as the site of the lesion. The sensorineural hearing loss developed during the earliest stages of meningitis. Permanent deafness was uncommon, but 10% of patients had an easily reversible cochlear impairment if the meningitis had been handled with early diagnosis promptly.

## Introduction

Meningitis is an inflammatory process, involving the leptomeninges within the subarachnoid space, if the infection spreads into the underlying brain; it is termed meningoenkephalitis. Infectious meningitis can be broadly divided into acute pyogenic, aseptic, and chronic.<sup>(1)</sup> Bacterial meningitis is more severe than the viral and remains a serious cause of morbidity and mortality despite antibiotic therapy.<sup>(2)</sup> Examination of the CSF is often useful in distinguishing between various causes of meningitis.<sup>(1)</sup>

Hearing loss usually divided into two types: (1) that caused by impairment of the cochlea or impairment of the auditory nerve, which is usually classified as "nerve deafness," and (2) that caused by impairment of the physical structures of the ear that conduct sound itself to the cochlea, which is usually called "conduction deafness."<sup>(3)</sup>

If either the cochlea or the auditory nerve is destroyed; the person becomes permanently deaf. However, if the cochlea and nerve are still intact but the tympanum ossicular system has been destroyed; sound waves can still be conducted into the cochlea by means of bone conduction from a sound generator applied to the skull over the ear.<sup>(3)</sup>

Deafness Hearing impairment occurs in 5% to 30% meningitis survivor is the most common serious complication of bacterial meningitis in children and is the leading cause of acquired deafness in infancy and childhood. It is believed that all types of hearing loss will evolve within the first few days of the illness. The pathologic mechanisms involved in loss of hearing after meningitis are uncertain.<sup>(4)</sup>

A technique of Oto Acoustic Emissions(OAEs) was used in hearing tests. OAEs are minute sounds created by the cochlea which can be recorded from almost all normal ears. Because the measurement of OAEs is rapid, we have been able to obtain sequential recordings; Because OAEs are abolished by

cochlear lesions but retained in retro cochlear (neural) deafness, we have been able to identify the location of the lesion in postmeningitic deafness. <sup>(4)</sup>

Aim of this study to determine the natural history and pathogenesis of hearing loss in children with bacterial meningitis.

## **Material and method**

This material and method are divide into meningitis and hearing test.

**Patient:** Between November 1993 and April 1995, children between the ages of 4 weeks and 16 years, were recruited from 21 hospitals in the south and west of England and South Wales. asked to be informed of all cases of bacterial meningitis within one hour of diagnosis. A working diagnosis was usually made on the basis of cerebrospinal fluid microscopy. Children with clinical signs of bacterial meningitis, but who were deemed too ill to undergo lumbar puncture were also recruited. To be included in the analysis children were required to have either specific bacteria identified on microscopy or culture of cerebrospinal fluid, and at least one other sign of bacterial infection. Children were treated with intravenous cefotaxime, ceftriaxone, or a combination of penicillin and chloramphenicol according to local policy. Dexamethasone also was given in some centres.<sup>(4)</sup>

**Hearing test:** Recordings of transient evoked OAEs were attempted as soon as possible after diagnosis. If OAEs were absent, the entire test procedure was repeated; to exclude methodological failure. Auditory brainstem responses were used to measure hearing thresholds shortly before discharge from hospital. Whenever possible ,brainstem responses were also measured earlier to confirm hearing impairments detected by OAEs.<sup>(4)</sup> Hearing impairments were classified as conductive, if the child had a brainstem threshold >30 dB HL, absent OAEs, and a type B tympanogram. Children with a raised threshold and normal tympanometry were classified as having a cochlear hearing loss, if OAEs were absent, or a retro cochlear hearing loss if OAEs were preserved.<sup>(4)</sup>

## Results

Ninety two children (74%) had meningococcal, and 18(15%) had pneumococcal meningitis. All cases of hearing loss were apparent at the time of the first assessment. Three children (2.4%) confidence interval (CI) (0.5 to 6.9%) had permanent sensorineural hearing loss. Thirteen children (10.5%) had evidence of hearing impairment at the time of their first assessments, but normal auditory function at discharge (table1). of whom nine had an impairment that resolved within 48 hours of diagnosis. It is believed that this 'fleeting' hearing loss has not been reported previously. The cochlea was identified as the site of the lesion, in both the permanent sensorineural and reversible impairments. Hearing loss was more common in children who had been ill for more than 24hours.<sup>(4)</sup>

Table 1 Details of children with severe reversible hearing loss

patient No	Sex	Age(years)	Pathogen	Time after diagnosis until	
				Hearing loss detected by OAE	Recovery of normal hearing
4	Male	0.3N	N meningitidis*	3 hours†	5 days
5	Female	0.4N	N meningitides	12 hours†	40 hours
6	Female	0.4N	N meningitidis*	8 hours†	20 hours
7	Male	0.4N	N meningitides	2 hours	42 hours
8	Female	0.4S	S pneumonia	3 hours	3 days
9	Male	0.8N	N meningitidis*	7 hours†	18 hours
10	Female	0.9N	N meningitides	2 hours†	42 hours
11	Female	2.5N	N meningitides	2 hours	5 days
12	Male	3.8N	N meningitides	8 hours	44 hours
13	Male	4.2N	N meningitidis*	5 hours†	21 hours
14	Male	7.4N	N meningitidis*	12 hours	42 hours
15	Male	10.5N	N meningitides	1 hour‡	48 hours
16	Male	12.1N	N meningitides	2 hours‡	14 hours

## Discussion

This study provides further evidence that hearing loss develops early in the course of bacterial meningitis. At the time of their first assessment, all children with hearing impairment were absent from OAEs.<sup>(4)</sup> In addition, at the presentation, three children actually complained about deafness.<sup>(4)</sup>

Since most children with hearing loss were unwell for 24 to 48 hours, this data suggest that hearing loss begins during the disease's first two days. There has been controversy about the cause of postmeningitic hearing loss. Cochlea lesions, auditory nerves, brainstem and higher centers were all indicated. In their research, OAEs were not developed by all children with sensorineural hearing loss; Because emission development is independent of the nervous system, this finding indicates that the cochlea in postmeningitic deafness is the site of the lesion.<sup>(4)</sup> OAEs and regular tympanograms were absent for all children with reversible hearing loss, This indicates cochlear dysfunction. They can only postulate as to the mechanism of this. It may result from the effects of bacterial toxins or inflammatory mediators on the hair cells of the organ of Corti.<sup>(4)</sup>

Certain theories include a secondary amebolic defect to low cerebrospinal fluid glucose, and the effect of changes in intracranial pressure, transmitted through the cochlear aqueduct. It is tempting to say that temporary hearing loss will result in permanent deafness unless meningitis was treated.<sup>(4)</sup>

Dexamethasone has been shown to substantially reduce the incidence of deafness in some studies, but the incidence of hearing loss in their population was actually higher among children treated with steroids. The period of symptoms has not been established as a definite risk factor for loss of sensorineural hearing.<sup>(4)</sup>

Nevertheless, hearing loss in children who had been ill for more than 24 hours was nearly three times as common. There is therefore some evidence that due to early diagnosis and prompt treatment, deafness was uncommon.<sup>(4)</sup>

Also In other study, Represents a large number of bacterial meningitis children in a major tertiary referral centre. Preadmission antibiotics are related to a decreased incidence of hearing loss. The main predictors for developing hearing loss in children with bacterial meningitis are decreased CSF glucose, the involvement of underlying neuropathies to the cranial nerve.<sup>(5)</sup>

The overall incidence of sensorineural hearing loss in all patients with bacterial meningitis was 30.6%. But the two articles differ regarding the bacteria, article 2 states that there was a higher incidence of hearing loss was seen in children infected with S pneumonia, while article 1 states N meningitidis.<sup>(5)</sup>

## **Conclusions**

They have shown that sensorineural hearing loss occurs very early in meningitis. In their analysis it was mainly cochlear in nature. A temporary hearing loss in 10% of their patients due to reversible cochlear dysfunction. It is likely that if the meningitis was not treated properly, this temporary hearing loss would have led to permanent deafness.

## **‘References’**

- 1- Kumar, V., Abbas, A., Aster, J., & Robbins, S. Robbins basic pathology (9th ed., pp. 825,826).
- 2- Samaranayake, L. Essential microbiology for dentistry (4th ed., pp. 211,212).
- 3- Hall, J. (2020). Guyton and hall textbook of medical physiology (11th ed., pp. 660, 661). [S.l.]: Elsevier - Health science.
- 4- Richardson MP, Reid A, Tarlow Hearing loss during bacterial meningitis MJ, et al Archives of Disease in Childhood 1997;76:134-138.
- 5- Kutz JW, Simon LM, Chennupati SK, Giannoni CM, Manolidis S. Clinical Predictors for Hearing Loss in Children With Bacterial Meningitis. Arch Otolaryngol Head Neck Surg. 2006;132(9):941-945.  
doi:10.1001/archotol.132.9.941