

Bacterial Meningitis after Cochlear Implantation among Children without Polyvalent Conjugate Vaccine: A Brief Report of an Iranian Cohort Study on 371 Cases

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ABSTRACT

Background: Regarding risk of bacterial meningitis (BM) after Cochlear implantation (CI), it was suggested to receive polyvalent conjugate vaccine. We aimed to estimate the prevalence of BM post CI in child recipients who do not receive polyvalent vaccine.

Methods: We enrolled 371 children who had received cochlear implants from 2007 to 2010. None of them received pre or post implantation polyvalent conjugate vaccine for BM. We followed all of them for BM for 2 years after implantation.

Results: We detected only one female case of BM (0.3% of patients) with the age of 24 months. The mean age of noninfected children was 36.7 ± 23.2 months. The education level of parents was “college level or higher” in less than half of them, and about 65% of patients were products of consanguineous marriage.

Conclusions: Our findings indicated that the incidence of BM was not higher in our cochlear implanted children who did not receive immunization than patients from countries in which routine vaccination is done. We suggest that although proper immunization is recommended before surgery, this procedure could be performed without vaccination, especially in developing countries that face financial problems for preparing vaccines.

Keywords: Bacterial meningitis, cochlear implantation, hearing loss, immunization

INTRODUCTION

The utilization of cochlear implant in children began from 1980.^[1] These instruments conduct electrical stimulation through their electrodes to a bundle of the cochlear nerve fibers and provide effective and safe method of rehabilitation for patients with severe to profound hearing loss.^[2,3] Early and late complications may follow this complex surgical dilemma.^[3] Apart from device, technique and human related complications, there is a higher risk of otogenic meningitis after this procedure. Children with a cochlear implant may have a greater risk of developing bacterial meningitis (BM) compared with the general population.

Cochlear implantation (CI) candidates, as well as those individuals who have already received the implant, may benefit from immunizations against organisms that commonly cause BM, particularly streptococcus pneumonia.^[5-6] All candidates for and recipients of cochlear implants should be up-to-date with their immunizations. However, polyvalent pneumococcal conjugate vaccine is not administered in routine vaccination schedule in our country. In this study, our aim was to detect the incidence of BM in cochlear implant recipients who do not receive routine polyvalent pneumococcal conjugate vaccine in their immunization program.

METHODS

In this prospective study, we studied 371 children with history of CI due to profound sensorineural hearing loss between 2007 and 2010. These children were followed-up after surgery to detect signs of developing BM.

None of the children received polyvalent pneumococcal conjugates vaccine before or after surgery, with regard to the fact that this vaccine is not utilized as a part of routine immunization program in our country. Moreover, the prophylactic antibiotic therapy before and after implantation did not performed in any cases.

The diagnostic criteria for BM were based on clinical and laboratory basis:^[1] Clinical findings in favor of meningitis such as headache, fever, drowsiness, neck stiffness, etc.^[2] Abnormal cerebrospinal fluid (CSF) analysis such as turbid appearance, increased protein, decreased glucose and increased leukocytes and^[3] the most important part was based on isolation of bacteria from blood or CSF. If the diagnosis of the BM was confirmed according to the above criteria, the patients were treated with a wide spectrum antibiotics based on antibiogram susceptibility test and trends of clinical symptoms and signs. A sub-specialist in pediatric infectious diseases was handled these patients.

RESULTS

From 371 patients with a cochlear implant, 1 patient (0.3%) experienced BM after surgery. The age of this female patient was 24 months, and mean age of patients without postsurgical meningitis was 36.7 ± 23.2 months. Parents of an infected child had consanguineous marriage and

educated up to secondary school. The infected child had a complete immunization history; and further interview with parents revealed that the child had a history of severe upper respiratory tract infection that caused her to be hospitalized during her first month of life. According to Table 1, the education level of parents was reported to be at "college level or higher" Less than one half of noninfected patients, while about 65% of patients were a product of consanguineous marriage. Almost all of the children showed a complete history of vaccination. The demographic data of the non-infected group is reflected in Table 1.

DISCUSSION

Complications such as mastoiditis and otogenic meningitis can also develop from a middle ear infection and are still potentially life-threatening. Unfortunately, in recent years more cases of meningitis after CI, even fatal, has been reported. On the other hand, there are numerous studies, which claim that the trauma caused by this surgical procedure can increase the risk of postsurgical bacterial infection.^[4,7,8-13] However, the extent of injury, which leads to postsurgical meningitis has

Table 1: Demographic and risk factors in noninfected children

	Noninfected patients (370 cases) (%)
Number	370 (99.7)
Gender	Male=166 Female=184
Mother's level of education	Primary school=136 (36.9) Secondary school=179 (48.5) College or higher=54 (14.6)
Father's level of education	Primary school=149 (40.4) Secondary school=143 (38.8) College or higher=77 (20.9)
Parents consanguinity	No=129 (35.5) Yes=234 (64.5)
Vaccination status	Incomplete=1 (0.3) Complete=369 (99.7)
Severe viral or bacterial infection during 1 st month of life	Yes=271 (75.4) No=89 (24.6)
History of hospitalization during 1 st month of life	Yes=81 (22.3) No=283 (77.3)
History of meningitis before surgery	Yes=11 (3) No=359 (97)

not yet been proven. There are some clinical studies, which have estimated the risk of meningitis after implantation.^[4] Some types of cochlear prostheses have been accompanied with a higher rate of meningitis possibly due to electrode array position, which is consisted of two components.^[14]

Today in developed countries, immunization against BM is a part of routine vaccination program and it is also recommended in children who undergo surgical procedures, which increase the risk of post operation meningitis. By means of wide immunization program, the incidence of meningitis has dramatically decreased. Results from the outcome of inducing immunization program in European and North American countries demonstrate the dramatic decrease in the incidence of BM among infants.^[15,16] In contrast, providing polyvalent meningitis vaccine for children and patients prone to BM is still a subject of challenge for developing countries, due to their financial burden.

There are numerous studies, which have proven the effect of socioeconomic factors, such as parental level of education on the incidence of meningitis in children. Low income, crowded families, and low educational levels of parents as well as some environmental factors (such as parental smoking habits) enhance the rate of meningitis in children.^[17,18] we also could detect that there was a trend for the higher number of infected children in families with lower level of education.

There are some similar studies, which conducted on the prevalence of BM in cochlear implanted children and they assessed the efficacy of vaccination in preventing this complication. In our study, the patients have not previously received vaccination although many studies confirmed the role of vaccination in preventing the meningitis.

We just found one case of BM among 371 implanted children and the rate of BM in our study was 0.3%. Based on US Food and Drug Administration's public health notification, "118 of the 60,000 people who received cochlear implants over the past 20 years have acquired meningitis."^[5] It means that in 2008, the worldwide rate of post implantation meningitis is equal to 0.002%, which is so less than our result. Moreover, they suggested that "pneumococcal meningitis is more likely in patients who receive CI, and that the surgical insertion technique and the cochlear implant design should be nontraumatic, and that

all cochlear implant recipients should be offered vaccination against *Streptococcus pneumoniae*."

Nowadays, in developed countries, polyvalent vaccine is used in patients' candidate for CI. The rate of meningitis in our study was 150 times more than the rate of post implantation meningitis in developed countries, but the overall prevalence of BM in our country,^[19] Iran (about 10 cases/100,000 population), is so higher than the prevalence in developed countries (1.38 cases/100,000 population).^[20] When this data was compared, it was cleared that the post implantation meningitis in our country was higher than in developed country as well as the higher prevalence of meningitis in Iranian general population compared to developed communities.

In a study in United States described that the incidence of pneumococcal meningitis in cochlear implanted children is 30 times higher than that for children in the general US population."^[11] While based on this study and other studies this ratio in Iran is 33 times. Therefore, the prevalence of post implantation meningitis compared to the general population in Iran and developed countries is almost similar. Also, in a review study by Wei *et al.* demonstrated that "Based on the current clinical literature, it is difficult to determine whether CI *per se* increases the risk of meningitis in subjects with no existing risk factors for acquiring the disease."^[21] Moreover, vaccination provide more effective protection against hematogenous bacterial source of meningitis, while it cannot be effective on the inner ear bacterial source of meningitis that is the important source of post implantation meningitis.^[4] On the other hand, cochlear device could be usefully implanted among post meningitis deaf children and also implantation works well after postsurgery meningitis also temporary loss of implant usage was reported.^[22,23]

CONCLUSIONS

We believe that the risk of meningitis after CI in children without pneumococcal immunization in our study was even lower than many other studies who utilized immunization against pneumococcal meningitis before and after surgery.^[24] However, this conclusion may be due to the small number of patients enrolled in the study, we are not able to give a strong suggestion about the matter. We can also conclude that CI could safely be performed in countries that

do not make use of pneumococcal vaccine in their routine schedule due to their consideration.

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REFERENCES

1. Clark GM, Cowan RS, Dowell RC, editors. Cochlear Implantation for Infants and Children: advances. A Singular Audiology Text. San Diego: Singular Pub. Group; 1997. p. 263.
2. Young N, Nguyen T, Wiet R. Cochlear implantation. *Oper Tech Otolaryngol Head Neck Surg* 2003;14:263-7.
3. Kim CS, Chang SO, Oh SH, Lee HJ. Complications in cochlear implantation. *Int Congr Ser* 2004;1273:145-8.
4. Wei BP, Robins-Browne RM, Shepherd RK, Azzopardi K, Clark GM, O'Leary SJ. Assessment of the protective effect of pneumococcal vaccination in preventing meningitis after cochlear implantation. *Arch Otolaryngol Head Neck Surg* 2007;133:987-94.
5. Wei BP, Robins-Browne RM, Shepherd RK, Clark GM, O'Leary SJ. Can we prevent cochlear implant recipients from developing pneumococcal meningitis? *Clin Infect Dis* 2008;46:e1-7.
6. Rose M, Hey C, Kujumdshiev S, Gall V, Schubert R, Zielen S. Immunogenicity of pneumococcal vaccination of patients with cochlear implants. *J Infect Dis* 2004;190:551-7.
7. Reefhuis J, Honein MA, Whitney CG, Chamany S, Mann EA, Biernath KR, *et al.* Risk of bacterial meningitis in children with cochlear implants. *N Engl J Med* 2003;349:435-45.
8. Cohen NL, Roland JT Jr, Marrinan M. Meningitis in cochlear implant recipients: The North American experience. *Otol Neurotol* 2004;25:275-81.
9. Angeli S, Balkany T. Post-cochlear implant meningitis. *Oper Tech Otolaryngol Head Neck Surg* 2003;14:293-6.
10. Biernath K, Reefhuis J, Whitney CG, Mann EA, Costa P, Boyle C. Bacterial meningitis in children with cochlear implants after twenty-four months post-implantation. *Am J Epidemiol* 2005;161:152-2.
11. Biernath KR, Reefhuis J, Whitney CG, Mann EA, Costa P, Eichwald J, *et al.* Bacterial meningitis among children with cochlear implants beyond 24 months after implantation. *Pediatrics* 2006;117:284-9.
12. Meli DN, Christen S, Leib SL, Täuber MG. Current concepts in the pathogenesis of meningitis caused by *Streptococcus pneumoniae*. *Curr Opin Infect Dis* 2002;15:253-7.
13. Arnold W, Bredberg G, Gstöttner W, Helms J, Hildmann H, Kiratzidis T, *et al.* Meningitis following cochlear implantation: Pathomechanisms, clinical symptoms, conservative and surgical treatments. *ORL J Otorhinolaryngol Relat Spec* 2002;64:382-9.
14. Available from: <http://www.fda.gov/medicaldevices/productsandmedicalprocedures/implantsandprosthetics/cochlearimplants/ucm062843.htm>. [Last accessed on 2014 Jul 01].
15. Black SB, Shinefield HR, Fireman B, Hiatt R, Polen M, Vittinghoff E. Efficacy in infancy of oligosaccharide conjugate *Haemophilus influenzae* type b (HbOC) vaccine in a United States population of 61,080 children. The Northern California Kaiser Permanente Vaccine Study Center Pediatrics Group. *Pediatr Infect Dis J* 1991;10:97-104.
16. Peltola H, Kilpi T, Anttila M. Rapid disappearance of *Haemophilus influenzae* type b meningitis after routine childhood immunisation with conjugate vaccines. *Lancet* 1992;340:592-4.
17. Reis JN, Palma T, Ribeiro GS, Pinheiro RM, Ribeiro CT, Cordeiro SM, *et al.* Transmission of *Streptococcus pneumoniae* in an urban slum community. *J Infect* 2008;57:204-13.
18. Stein-Zamir C, Abramson N, Zentner G, Shoob H, Valinsky L, Block C. Invasive meningococcal disease in children in Jerusalem. *Epidemiol Infect* 2008;136:782-9.
19. Mosavi-Jarrahi A, Esteghamati A, Asgari F, Heidarnia M, Mousavi-Jarrahi Y, Goya M. Temporal analysis of the incidence of meningitis in the Tehran metropolitan area, 1999-2005. *Popul Health Metr* 2009;7:19.
20. Thigpen MC, Whitney CG, Messonnier NE, Zell ER, Lynfield R, Hadler JL, *et al.* Bacterial meningitis in the United States, 1998-2007. *N Engl J Med* 2011;364:2016-25.
21. Wei BP, Shepherd RK, Robins-Browne RM, Clark GM, O'Leary SJ. Pneumococcal meningitis post-cochlear implantation: Potential routes of infection and pathophysiology. *Otolaryngol Head Neck Surg* 2010;143:S15-23.
22. Mancini P, D'Elia C, Bosco E, De Seta E, Panebianco V, Vergari V, *et al.* Follow-up of cochlear implant use in patients who developed bacterial meningitis following cochlear implantation. *Laryngoscope* 2008;118:1467-71.
23. Hasanlifar M, Ajalloueyan M, Amirsalari S, Saburi A. Outcome of cochlear implantation in post-meningitis deaf children. *Iran Red Crescent Med J* 2013;15:15-7.
24. Wilson-Clark SD, Squires S, Deeks S, Centers for Disease control and prevention (CDC). Bacterial meningitis among cochlear implant recipients – Canada, 2002. *MMWR Morb Mortal Wkly Rep* 2006;55 Suppl 1:20-4.

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