

Epidemiology Of Pyogenic Meningitis Among Children In Barbados: A Population-Based Study Of The Impact Of Hemophilus Influenza Type B Vaccine

A Kumar, A Jennings, D Louis

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Abstract

Objectives: to describe the changing epidemiology of pyogenic meningitis and Hemophilus influenza type b meningitis prior to and after the introduction of the vaccine.

Methods: A population based retrospective study. We conducted a retrospective chart review of all the cases of pyogenic meningitis in children during the twelve years period from 1994 through 2005.

Results: Of the 66 cases of pyogenic meningitis, 55(83.3%) of children were < 5 years of age and 40(60.6%) were males. Over all Hemophilus influenza type b was the cause in 50% of all childhood pyogenic meningitis, 56.4% of meningitis in children less than 5 years and 66% of meningitis in children less than 2 years. The mean annual incidence of Hemophilus influenza type b meningitis in under 5 years children decreased from 23.29 per 100, 000 population during 1994 through 2002 when no vaccine was used to 5.5 per 100, 000 population during the 2003 -05 when vaccine was routinely used. Incidence of the pneumococcal meningitis in children under 5 years increased from 14.37 per 100, 000 population during 1994 through 1998 to 42.91 per 100, 000 population during 2001-05.

Conclusions: Since the routine use of vaccine, there has been a significant drop in the incidence of Hemophilus influenza type b meningitis. However, the effect of this decline on the over all incidence of pyogenic meningitis has been dampened by an increase in the incidence of pneumococcal meningitis in the recent years.

INTRODUCTION

The epidemiology of childhood pyogenic meningitis has been constantly changing over the past two decades (1). With the advent of conjugate hemophilus influenza vaccine both the incidence of over all pyogenic meningitis and the incidence of pyogenic meningitis due to hemophilus influenza have declined (1,2,3). Several studies have characterized the epidemiology of the pyogenic meningitis in the English speaking Caribbean including Barbados in the eighties and early nineties (4,5,6). Since early two thousand many Caribbean countries including Barbados have been using conjugated hemophilus influenza vaccine to routinely immunize all the children. However, there is no recent published report on the pattern of meningitis from the English speaking Caribbean. In this study, we describe the epidemiology of the meningitis in children in Barbados,

during a 12 year period, from 1994 to 2005, with a particular emphasis on the trends in incidence, age distribution and etiology of pyogenic meningitis. We also studied the impact of the introduction of the hemophilus influenza type b conjugate vaccine on the incidence and the etiology of pyogenic meningitis in this population.

METHODS

Barbados is one of the smaller countries in the English speaking Caribbean, with an estimated 2001 population of 266,800. The Government of Barbados views health care as a fundamental right of all Barbadians and aims to provide comprehensive health care to all its citizens through its elaborate government controlled health care facilities, free of cost at the point of delivery. There is an excellent system for the care and follow of healthy children including

immunization for the 10 vaccine preventable diseases (Diphtheria, Pertusis, Tetanus, Hemophilus influenza type b, Hepatitis B, Poliomyelitis, Mumps, Measles, Rubella and Tuberculosis). The uptake of this facility is nearly universal and immunization coverage is close to 100% by 5 years of age. Immunization with Hemophilus influenza type b (Hib) was added to the expanded immunization program in 2000 and all the children receive three doses of Hib conjugate vaccine at the age of 3 months, four and a half months and six months as primary immunization and a booster dose at 18 months along with DPT and Polio. The Queen Elizabeth Hospital (QEH) is the only tertiary care hospital in Barbados providing inpatient care for sick children. Therefore, nearly all the children with suspected meningitis in Barbados are admitted to this hospital.

This is a population based retrospective study. For this report we included all cases of culture positive pyogenic meningitis in Barbados during the twelve years period from 1994 through 2005. Cases of pyomeningitis were defined by either a positive culture from the CSF or a pleocytosis in the CSF with a positive blood culture for a bacterial pathogen. Cases were excluded for the following reasons: age <30 days, neurosurgical procedure before the onset of meningitis, presence of a shunt within the central nervous system, or presence of a known immunodeficiency.

A retrospective chart review was conducted of all children outside of the neonatal age group and who were less than 16 years of age and hospitalized at the QEH and where the final discharge diagnosis was pyogenic meningitis. An all inclusive list of all the pediatric patients with the suspected meningitis and where a CSF study was ordered was compiled from the pathology departments CSF study register. Data from the laboratory was supplemented by the data from the patient's case record notes. Additional data was collected on all the patients with the culture positive pyogenic meningitis and included, demographic information, date of admission to the hospital for the pyogenic meningitis, and CSF study results. All the data was stored in a specially designed Microsoft database and Microsoft excel was used for generating tables and graphs. Incidence rates were calculated by dividing the number of cases by the age specific mid year population and expressed as number of cases/100, 000 populations. For categorical variables, the Pearson ² test was used to assess between group differences.

RESULTS

In Barbados, during the twelve years period from 1994

through 2005, there were 66 cases of pyogenic meningitis diagnosed in other wise healthy children beyond their neonatal period and who were < 16 years of age. During the same period, there were 327 cases of meningitis based on the evidence of inflammation from the CSF study and 235 cases were categorized as aseptic meningitis and 92 were categorized as bacterial meningitis including 26 cases where culture from CSF or blood was negative. Over all, 54(83.1%) of children were < 5 years of age and over half (53.8%) of all cases of pyomeningitis occurred in children < 2 years of age. Forty (61.5%) cases occurred in males (Table 1). The median age at the time of diagnosis of pyogenic meningitis was 18 months with range of 1 month to 190 month.

Figure 1

Table 1: Selected profile of the 66 children with pyomeningitis diagnosed during 1994 through 2005.

Age distribution	
< 4 Years	55 (83.3)
5 – 8 Years	6 (9.1)
9 – 12 Years	1 (1.5)
13 – 16 Years	4 (6.1)
Gender distribution	
Females	26 (39.4)
Males	40 (60.6)
Organism isolated	
Hemophilus influenza type b	33 (50)
Streptococcus pyogenus	28 (42.4)
Nesseria meningitides	2 (3.1)
Others	3 (4.5)

The incidence of pyogenic meningitis among children under 5 years of age in Barbados during the 1994 through 2002 varied between 37.45 and 66.42 per 100 000 population with an average annual incidence of 54.79 per 100 000 population (Figure 1) and decreased ($P < 0.001$) to an average annual incidence of 41.17 per 100 000 population during 2003 through 2005 (Range 31.2, 57.97). Over all, Hemophilus influenza type b (50%) was commonest cause of pyogenic meningitis followed by Sreptococcus pneumoniae in 42.4% of cases (Table 1). Figure 2 show the proportion of all the cases of pyomeningitis that was due to the Hemophilus influenza type b in various age groups. Only 2(16.7%) cases of all culture proven pyomeningitis were due to Hemophilus influenza type b in children over 4 years of age where as

nearly two – thirds (66%) of all pyogenic meningitis in children younger than 2 years were due to Hemophilus influenza type b infection.

Figure 2

Figure 1: Trends in the causes of pyogenic meningitis in children under 5 years of age.

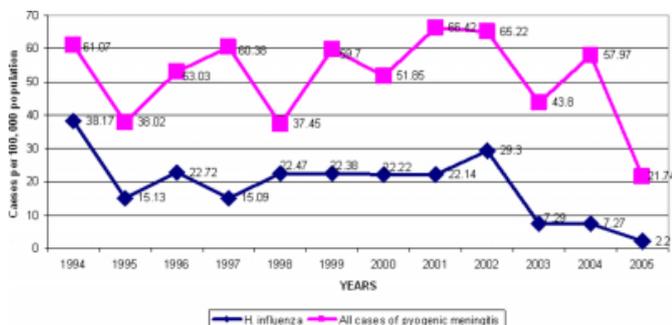
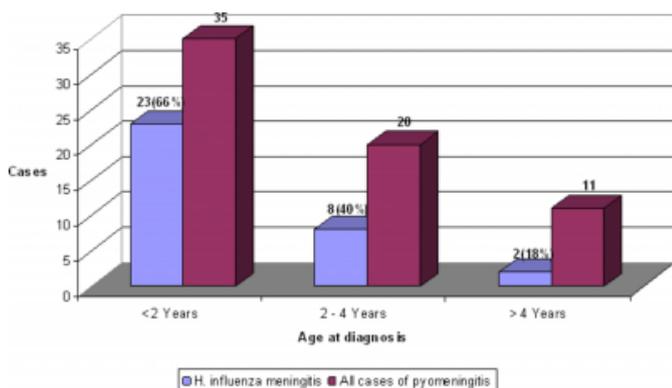


Figure 3

Figure 2: Age distribution of H. influenza meningitis in Barbados.



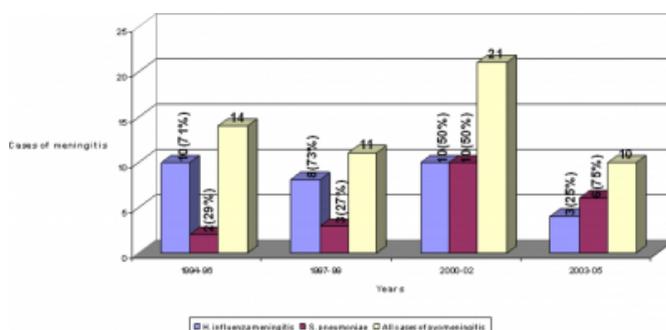
Trends in the incidence of Hemophilus influenza type b meningitis in children under 5 years of age is shown in Figure 1. During the 1994 through 2002, the annual incidence of Hemophilus influenza type b meningitis in Barbados varied between 15.09 to 38.17 per 100, 000 under five years children population with a mean annual incidence of 23.29 100, 000 under five years children population where as during the 2003 through 2005, the incidence varied between 2.2 and 7.29 per 100, 000 under 5 year children population with a mean annual incidence of 5.5 per 100, 000 under five years children population (P = 0.0013).

During the 1994 – 97 periods, 71% of all cases of pyomeningitis in children younger than 16 years in age were due to the Hemophilus influenza type b and 29% were due to the Streptococcus pneumoniae infections. Where as, during the 2003 – 05, 25% of all pyomeningitis in children less than

16 years were due to Hemophilus influenza type b and 75% were due to Streptococcus pneumoniae infections (Figure 3). This change in the pattern of the bacteriological isolation was statistically significant (P <0.001). An analysis of the Incidence of the pneumococcal meningitis in children under 16 years over the study period revealed an absolute increase from 14.37 per 100, 000 population during 1994 through 1998 to 42.91 per 100, 000 population during the 2001 through 2005 (P < 0.001).

Figure 4

Figure 3: Trends in the bacteriological causes of pyomeningitis in Barbados.



DISCUSSIONS

A captive island population, predominantly of Afro-Caribbean origin provided an excellent opportunity for studying the impact of universal immunization with the conjugate Hemophilus influenza type b vaccine on the incidence of Hemophilus influenza type b meningitis in children. This is the first such study form the English speaking Caribbean countries and indeed one of the few such studies in children of African origin. We also studied the trend in the incidence of pneumococcal meningitis and meningitis form other causes in children with the idea of exploring the necessity of immunization for other common organism causing child hood meningitis in this population. This is very timely since efficacious conjugate vaccine for both the pneumococcus and meningococcus has become accessible.

Globally, Haemophilus influenzae type b (Hib) has been one of the leading causes of bacterial meningitis in children <5 years of age not immunized with the Haemophilus influenzae type b vaccine (7). In Barbados too, Hemophilus influenza type b was the leading cause of pyomeningitis in children younger than 5 years up until the 2000. However, the incidence (mean annual incidence of 23.29 per 100, 000 population) of Haemophilus influenzae type b meningitis seen in this population in the preimmunization era is some

what higher than those reported from the European countries (8,9,10) and from the other Caribbean countries (11) and Latin Americas (12).

Hib vaccine was introduced as a part of routine immunization in Barbados in 2001 with a significant drop in the incidence of Hemophilus influenza meningitis with a 75% decline in the mean annual incidence since 2003 compared to those before 2003. Similar declines have been noted in reports from the developing countries where Hib vaccine is being routinely used (12,23, 13, 14). Since the 2003, Streptococcus pneumoniae contributes to over three-fourths of all cases of pyomeningitis in children younger than 16 years of age while Hemophilus influenza type b contributes to only one –fourth of all cases of pyomeningitis in this age group.

Although, the incidence of Hemophilus influenza type b meningitis in this country has declined significantly (Figure 1), there has not been any significant decline in the over all incidence of pyogenic meningitis. This is mainly due to the concurrent and significant increase in the incidence of the pneumococcal meningitis children less than 5 years caused by the Streptococcus pneumoniae. The mean annual incidence of pneumococcal meningitis during 2001-05 tripled compared with those during the 1994 through 1998. An increase in the incidence of invasive pneumococcal disease has also been reported from other countries where pneumococcal vaccine is not used routinely (15, 16).

Presently there is an efficacious and safe conjugate pneumococcal vaccine available for routine use in children (17,18,19,20). The findings from this study strongly support the need for the routine use of the conjugate pneumococcal vaccine in children of this country. However, before we consider using the conjugate pneumococcal vaccine with the limited number of strains (Prevnar® the seven valent vaccine) there is a need for a detailed epidemiological study of the invasive pneumococcal disease and the prevalent strains in this population. With the continued use of the Hib vaccine and introduction of the conjugate pneumococcal vaccine, the incidence of meningitis and other invasive infection can be significantly reduced.

CORRESPONDENCE TO

Alok Kumar, MD. Lecturer in Child Health The Queen Elizabeth Hospital School of Clinical Medicine & Research University of West Indies (Cave Hill Campus) BARBADOS (West Indies) FAX: (246) 429 5374 Email:

alokkumar.uwichill@gmail.com , bhavna@sunbeach.net

References

1. Dawson KG, Emerson JC, Burns JL. Fifteen years of experience with bacterial meningitis. *Pediatr Infect Dis J.* 1999 Sep;18(9):816-22.
2. Neuman HB, Wald ER. Bacterial meningitis in childhood at the Children's Hospital of Pittsburgh: 1988-1998. *Clin Pediatr (Phila).* 2001 Nov;40(11):595-600.
3. Dickinson FO, Perez AE. Bacterial meningitis in children and adolescents: an observational study based on the national surveillance system. *BMC Infect Dis.* 2005 Nov 15;5:103.
4. St John MA. Bacterial meningitis in children in Barbados. *West Indian Med J.* 1981 Dec;30(4):202-6.
5. St John MA. Childhood bacterial meningitis in Barbados: focus on Haemophilus influenzae. *J Trop Pediatr.* 1995 Jun;41(3):190-1.
6. Sharma A, Sharma DP, Prabhakar P. Infectious meningitis at the University Hospital of the West Indies. Review of clinical and laboratory findings (1965-1980). *West Indian Med J.* 1984 Mar;33(1):14-30.
7. WHO Global Programme for Vaccines and Immunization. The WHO position paper on Haemophilus influenzae type b conjugate vaccines. *Weekly Epidemiological Record* 1998;73:64-8.
8. Novakova E, Gessner BD, Olear V. Incidence of Haemophilus influenzae type b meningitis among children less than 5 years of age in Slovakia. *Eur J Clin Microbiol Infect Dis.* 1999 Jun;18(6):409-13.
9. Dagan R, Isaachson M, Lang R, Karpuch J, Block C, Amir J. Epidemiology of pediatric meningitis caused by Haemophilus influenzae type b, Streptococcus pneumoniae, and Neisseria meningitidis in Israel: a 3-year nationwide prospective study. *Israeli Pediatric Bacteremia and Meningitis Group. J Infect Dis.* 1994 Apr;169(4):912-6.
10. Kojouharova M, Gatcheva N, Setchanova L, Robertson LS, Wenger JD, & the Bulgarian Hib Study Team. Epidemiology of meningitis due to Haemophilus influenzae type b in children in Bulgaria: a prospective, population-based surveillance study. *Bull World Health Organ* vol.80 no.9 Geneva Sept. 2002
11. Gomez E, Peguero M, Sanchez J, Castellanos PL, Feris J, Pena C, Brudzinski-LaClaire L, Levine OS. Population-based surveillance for bacterial meningitis in the Dominican Republic: implications for control by vaccination. *Epidemiol Infect.* 2000 Dec;125(3):549-54.
12. Asturias EJ, Soto M, Menendez R, Ramirez PL, Recinos F, Gordillo R, Holt E, Halsey NA. Meningitis and pneumonia in Guatemalan children: the importance of Haemophilus influenzae type b and Streptococcus pneumoniae. *Rev Panam Salud Publica.* 2003 Dec;14(6):377-84.
13. Dash N, Ameen AS, Sheek-Hussein MM, Smego RA Jr. Epidemiology of meningitis in Al-Ain, United Arab Emirates, 2000-2005. *Int J Infect Dis.* 2006 Sep 1
14. Wenger JD. Epidemiology of Haemophilus influenzae type b disease and impact of Haemophilus influenzae type b conjugate vaccines in the United States and Canada. *Pediatric Infectious Disease Journal* 1998;17 Suppl 9:S132-6.
15. Byington CL, Samore MH, Stoddard GJ, Barlow S, Daly J, Korgenski K, Firth S, Glover D, Jensen J, Mason EO, Shutt CK, Pavia AT. Temporal trends of invasive disease due to Streptococcus pneumoniae among children in the intermountain west: emergence of nonvaccine serogroups.

16. Kaltoft, Zeuthen N, Konradsen HB. Epidemiology of invasive pneumococcal infections in children aged 0-6 years in Denmark: a 19-year nationwide surveillance study. *Acta Paediatr Suppl.* 2000 Dec;89(435):3-10
17. Haddy RI, Perry K, Chacko CE, Helton WB, Bowling MG, Looney SW, Buck GE. Comparison of incidence of invasive *Streptococcus pneumoniae* disease among children before and after introduction of conjugated pneumococcal vaccine. *Pediatr Infect Dis J.* 2005 Apr;24(4):320-3.
18. Kaplan SL, Mason EO Jr, Wald ER, Schutze GE, Bradley JS, Tan TQ, Hoffman JA, Givner LB, Yogev R, Barson WJ. Decrease of invasive pneumococcal infections in children among 8 children's hospitals in the United States after the introduction of the 7-valent pneumococcal conjugate vaccine. *Pediatrics.* 2004 Mar;113(3 Pt 1):443-9.
19. Hsu K, Pelton S, Karumuri S, Heisey-Grove D, Klein J; Massachusetts Department of Public Health Epidemiologists. Population-based surveillance for childhood invasive pneumococcal disease in the era of conjugate vaccine. *Pediatr Infect Dis J.* 2005 Jan;24(1):17-23.
20. Black SB, Shinefield HR, Hansen J, Elvin L, Laufer D, Malinoski F. Postlicensure evaluation of the effectiveness of seven valent pneumococcal conjugate vaccine. *Pediatr Infect Dis J.* 2001 Dec;20(12):1105-7.

Author Information

Alok Kumar, M.D.

School of Clinical Medicine and Research, UWI (Cave Hill) and the Queen Elizabeth Hospital

Angela Jennings, M.D.

School of Clinical Medicine and Research, UWI (Cave Hill) and the Queen Elizabeth Hospital

Delores Louis, M.D.

School of Clinical Medicine and Research, UWI (Cave Hill) and the Queen Elizabeth Hospital