Hemophilus influenzae type b is a major cause of serious, invasive infections in infants and children. It causes most cases of bacterial meningitis, nearly all cases of epiglottitis, and a substantial number of the cases of bacterial pneumonia, septic arthritis, febrile bacteremia, and facial cellulitis in young children. Hemophilus influenzae strains causing otitis media and sinusitis are usually nonencapsulated.

In spite of advances in the diagnosis and therapy of H influenzae type b infections, the mortality and morbidity remain appreciable. Approximately 3% to 10% of children with H influenzae type meningitis die, and 25% to 50% of survivors are reported to have neurologic sequelae. Epiglottitis is a life-threatening emergency and may result in sudden, unpredictable airway obstruction.

The incidence of H influenzae type b infection is highest during infancy, with the peak between 6 and 12 months of age (Table); epiglottitis is an exception; the mean age of occurrence is 44 months. Other risk factors include the following: (1) household contact with a patient with invasive H influenzae type b disease; (2) day care attendance; (3) functional or anatomic asplenia including sickle cell anemia; (4) immunosuppression, including patients with Hodgkin disease; and (5) agammaglobulinemia. An increased incidence of invasive H influenzae type b disease has also been reported in certain population groups, such as American Indians, Alaskan Eskimos, and blacks. Genetic factors have also been implicated in disease susceptibility.

**CLINICAL STUDIES**

A vaccine consisting of the purified H influenzae type b capsular polysaccharide has been licensed for use in the United States. Recommendations for use are based primarily on a study performed in Finland in which such a vaccine was given to nearly 50,000 children between 3 and 71 months of age. During the first 4 years following immunization of children between 18 and 71 months of age, significantly fewer cases of invasive H influenzae type b infections were observed in children who received H influenzae type b vaccine than in control subjects, some of whom received meningococcal type A vaccine (P < .001). In children immunized between 18 and 23 months of age, however, a significant difference in the incidence of H influenzae type b infection was not demonstrable.

**IMMUNOGENICITY**

Considerable evidence indicates that antibody against the type b capsule confers protection against invasive H influenzae type b disease. The concentration of serum antibody against H influenzae type b capsular polysaccharide that confers protection is not known, but it has been estimated that a concentration of antcapsular antibody of 1.0 µg/mL or greater, 3 weeks after immunization or a level of 0.15 µg/mL subsequent to this time is required.

The ability of purified H influenzae type b capsular polysaccharide vaccines to protect the very young is limited by their poor serum antibody responses; 45% of Finnish children aged 12 to 17 months compared with 90% of those aged 24 to 71 months had postimmunization titers of 1 µg/mL, respectively. Children immunized beyond the first year of life demonstrate progressively greater anticapsular antibody responses with increasing age, as determined by both the frequency of serum antibody increase and mean concentration of anti-H influenzae type b polysaccharide antibody.

**TABLE.** Age Distribution of Patients with Hemophilus influenzae Type b Disease in Children Less than 5 Years of Age, United States, 1984*

<table>
<thead>
<tr>
<th>Age (mo)</th>
<th>Meningitis</th>
<th>Other</th>
<th>Total Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Attack Rate</td>
<td>Cases</td>
<td>Attack Rate</td>
</tr>
<tr>
<td>0-5</td>
<td>112</td>
<td>2,099</td>
<td>41</td>
</tr>
<tr>
<td>6-11</td>
<td>192</td>
<td>3,579</td>
<td>106</td>
</tr>
<tr>
<td>12-17</td>
<td>113</td>
<td>2,089</td>
<td>49</td>
</tr>
<tr>
<td>18-23</td>
<td>59</td>
<td>1,083</td>
<td>63</td>
</tr>
<tr>
<td>24-35</td>
<td>33</td>
<td>1,222</td>
<td>23</td>
</tr>
<tr>
<td>36-47</td>
<td>17</td>
<td>597</td>
<td>30</td>
</tr>
<tr>
<td>48-59</td>
<td>8</td>
<td>272</td>
<td>16</td>
</tr>
<tr>
<td>Totals</td>
<td>60</td>
<td>10,940</td>
<td>40</td>
</tr>
</tbody>
</table>

* Estimates from the Centers for Disease Control.
† Cases per 100,000 children per year.


**influenzae type b antibody achieved after immunization.**

In the United States, about 40% of invasive *H influenzae* type b disease in children occurs in those 18 months of age and older; 12% occurs in those aged 18 to 23 months (Table). It has been reported that 75% of Finnish infants between 18 and 23 months of age achieved postimmunization levels of 1 μg/mL or greater. However, at age 18 months, the time of the scheduled "well-child" visit, fewer infants achieved this level than did infants closer to 23 months of age.

Recommendations for use in children with sickle cell anemia or asplenia are made on the basis of increased risk and presumed normal immune response. There are few data on the immunogenicity of this vaccine and no data on actual protection.

Patients with Hodgkin disease 24 months of age or older, including adults, should be immunized. Most experts believe that these patients are at increased risk for invasive *H influenzae* type b infection. Based on the experience with pneumococcal vaccine in these patients, the antibody response is likely to be best when patients are immunized at least ten to 14 days prior to initiation of therapy for Hodgkin disease. During active chemotherapy and shortly thereafter, the antibody response to *H influenzae* type b capsular polysaccharide vaccine is impaired. However, the ability of these patients to respond to this vaccine improves rapidly following cessation of chemotherapy. Therefore, it is reasonable to immunize these patients as early as 3 months following the cessation of chemotherapy.

**SIDE EFFECTS AND ADVERSE REACTIONS**

Polysaccharide vaccines are among the safest of all vaccine products. To date, more than 60,000 doses of *H influenzae* type b capsular polysaccharide vaccine have been administered to children, and several hundred doses have been given to adults. Only one serious systemic reaction has been reported in a child who had possible anaphylactoid reaction that responded promptly to epinephrine injection. High fever (>38.5°C) has been reported in less than 1% of vaccine recipients. Mild local reactions are common; however, at 24 hours after immunization they were observed in only 1.5% of children. DTP has been given together with *H influenzae* type b polysaccharide vaccine without increasing the incidence of reactions.

**RECOMMENDATIONS**

Recommendations for use of *H influenzae* type b vaccine are as follows:

1. Immunization against *H influenzae* type b disease is recommended for all children at 24 months of age. For those who have not received the vaccine at this age, immunization before the fifth birthday (60 months of age) will prevent some cases of invasive *H influenzae* type b disease (Table), and should be given. The need for additional doses of vaccine has not been established. Special efforts should be made to immunize those in day care.

2. For infants 18 to 23 months of age, there are insufficient data upon which to base a recommendation regarding vaccine administration. If vaccine is administered to an infant in this age group, it should be recognized that the likelihood of protection is uncertain. Parents should be aware of this uncertainty and know that additional immunization may be required at 24 months or later.

3. Vaccine is not recommended for infants younger than 18 month sof age.

4. Children even beyond the fifth birthday (60 months of age) who have chronic illness known to be associated with increased risk for *H influenzae* type b disease should be given a single dose of vaccine. These illnesses include anatomic or functional asplenia as well as sickle cell disease; also affected are children who have undergone splenectomy. Patients with Hodgkin disease should be immunized ten to 14 days or more prior to the initiation of chemotherapy. If this cannot be done, such patients may be immunized as early as 3 months after cessation of chemotherapy. There is no known contraindication to giving *Hemophilus* b polysaccharide vaccine and pneumococcal vaccine at the same time in separate syringes at different sites.

5. Children with deficiencies of immunoglobulin synthesis will probably not benefit from the vaccine. As in the past, they should receive periodic doses of immune globulin.

**OTHER VACCINES**

New *Hemophilus influenzae* type b vaccines are currently being evaluated. Preliminary evidence suggests that capsular polysaccharide conjugated to one of several protein antigens is considerably more immunogenic than the polysaccharide alone in all age groups. A field trial of one of these conjugate vaccines is currently in progress to determine the safety and protective efficacy in infants during the first year of life.
HEMOPHILUS TYPE b POLYSACCHARIDE VACCINE

REFERENCES

Hemophilus Type b Polysaccharide Vaccine

Pediatrics 1985;76;322

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