UNIT NO. 2

ROUTINE PAEDIATRIC VACCINES

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ABSTRACT

The routine vaccines in the National Immunization Program covers nine diseases; namely tuberculosis, hepatitis B, diphtheria, pertussis, tetanus, poliomyelitis, measles, mumps and rubella. The coverage of the vaccines have been high and have resulted in decline of these diseases. This article reviews the history of the vaccines and the impact of vaccination on these diseases.

KEYWORDS: National immunization programme, immunization, tuberculosis, BCG, hepatitis B, Diphtheria, pertussis, tetanus, poliomyelitis, measles, mumps, rubella, vaccination, combination vaccines.

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TUBERCULOSIS IN SINGAPORE

Tuberculosis(TB) was a leading cause of death in the first half of the twentieth century. BCG vaccination was given to all newborns from 1957. This, together with a comprehensive TB Control Program which included early detection of TB cases, chemoprophylaxis for infected contacts and improved socioeconomic conditions led to a decline of TB cases from 307 per 100,000 population in 1960 to 47 per 100,000 in 2000. The coverage for BCG vaccination was 98% at birth in 2000. The schedule at the time was BCG vaccination at birth and a second BCG vaccination was given to children at 12 or 16 years depending on their reaction to the tuberculin or Mantoux skin test.

BCG Vaccination at birth has been shown to be highly effective in preventing serious forms of childhood TB such as meningitis and disseminated TB. However there is no scientific evidence to show that repeated BCG vaccination is effective in protecting against TB. As a result, in July 2001, the practice of a second BCG vaccination was discontinued.¹

HEPATITIS B INFECTION IN SINGAPORE

Hepatitis B(HBV) infection was a common cause of hepatitis in Singapore accounting for 24% to 54% of the acute viral hepatitis cases. This results in a large reservoir of Hepatitis B surface antigen(HBsAg) carriers especially in adults. 39% of the

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HBsAg carriers were Hepatitis B e antigen positive.² The carrier state is closely associated with the subsequent development of chronic hepatitis in 50%, liver cirrhosis in 20% and liver cancer. Up to 97% of patients with hepatocellular carcinoma have been found to have evidence of previous HBV infection.³ The main mode of transmission in the first year of life is perinatal with 43% of the babies born to HBsAg positive mothers developing the carrier state. Horizontal transmission within the infected household was associated with the sharing of personal and household articles.²

A national childhood immunization program was implemented in Oct 1985 for babies born to carrier mothers and subsequently extended to all newborns in 1987. The coverage of infants completing the full course of immunization below 1 year was maintained at more than 90%.

The incidence rate of indigenous cases of acute Hepatitis B has declined from 9.5 per 100,000 in 1985 to 1.0 per 100,000 in 2001. In children below 15 years of age, it dropped from 1.4 per 100,000 during 1983-1985 to 0 per 100,000 for the period between 1998-2001. For babies born to carrier mothers vaccinated with a primary course of three doses of Hepatitis B vaccine, perinatal transmission has reduced by 80%-100%, with no carriers detected in babies of hepatitis B e antigennegative mothers.

Serological surveys of the general population aged from 6 months to above 45 years conducted in 1993 and 1998 showed that none of the vaccinated persons were HBsAg positive, whereas the antigen was detected in 4-5% of unvaccinated persons.⁴

DIPTHERIA, PERTUSSIS, TETANUS AND POLIOMYELITIS

In 2000, 91% of infants completed their primary course of diphtheria/pertussis/tetanus (DPT) vaccination below 1 year of age. An estimated 88% of pre-school children below 2 years received the first DPT booster. 91.4% of primary school children received the second booster(DT) and 94.7% of primary school leavers received the third booster(DT). The booster doses have been simplified to only one booster dose to be given at 10-11 years of age after the first booster at 18 months of age.

The immunization coverage for polio vaccination was also high with 90.2% of infants completing the primary course, 87% receiving the first booster before 2 years, 91.4% the second booster at Primary 1 and 93.8% the third booster at Primary 6.

There were no cases of diphtheria, poliomyelitis and

neonatal tetanus reported in 2000.⁵ The exception has been pertussis which reported a marked increase in the number of cases from about 2 cases per year to 37 cases per year in 2007. Most of the children were below the age of 6 months and had not received their primary course of pertussis immunization. High attack rates have also been observed among adolescents and adults. A seroepidemiology of pertussis in Singapore adult population revealed high seroprevalence rates of 97% suggesting natural infection with pertussis in the community.⁶ This results in increased transmission of infection to infants from infected household contacts. A pertussis booster vaccine such as dtpa(Boostrix) is recommended to children at 10-11 years of age instead of DT.

MEASLES, MUMPS AND RUBELLA

Measles vaccination was introduced into the national childhood immunization program in 1976. The initial vaccination acceptance was low with only 24.6% being vaccinated in 1977. Measles vaccination was made compulsory by law in 1985 for all children between 1 and 2 years of age. The vaccine coverage improved to 95% in 1987. MMR vaccine was introduced in 1990. Despite high vaccine coverage of between 85%-89%, there was a resurgence of measles in 1992 and 1993 and again in 1997. This problem was observed in all countries with a single dose of measles vaccination given. A 'catch-up' measles vaccination campaign was implemented for all secondary and pre-university students aged 12-18 years. In 1998, a 2 dose measles vaccination schedule was introduced with the second dose of MMR given to all primary school leavers at Primary 6. Vaccine coverage for MMR is also high with 92.5% of children below 2 years of age receiving the vaccine. A second dose of MMR was administered to 94.8% of Primary 6 students. This has resulted in a marked reduction in measles cases with an incidence rate of 1.7 per 100,000. As a result of an outbreak of measles in 2004 in a primary school where 9 children contracted measles before they could receive the booster dose, the booster dose has been moved now to be given at Primary 1 instead of Primary 6.7

The incidence of rubella has decreased significantly from a peak of 13.3 per 100,000 in 1996 to 1.8 per 100,000 in 2007. Congenital rubella syndrome has virtually disappeared.⁸

The resurgence of mumps which began in 1998 was due to the use of the Rubini strain in the MMR vaccine.⁹ This has since been discontinued and current mumps vaccines are derived form the Jeryl-Lynn strain. The number of cases of mumps has since stabilized.

COMBINATION VACCINES

The combination vaccines consisting of DTaP-IPV-HiB or DTaP-IPV-HiB-HBV are now available to be given as primary doses for infants. These vaccines have become available since the turn of the century. They allow for fewer doses and increased coverage of diseases.

The new combination vaccines make use of the acellular pertussis vaccine instead of the whole cell pertussis. The acellular pertussis vaccines has been shown to be effective and better tolerated than the whole cell pertussis vaccine.¹⁰

Use of the combination DTaP-IPV-HiB-HBV in the first and second year of life have been shown to have lasting immune memory against hepatitis B after primary dosing with 4 doses. Children were assessed at 4-5 years of age for persisting anti-HBs antibody concentrations and following a challenge dose with monovalent HBV vaccine. 85.3% had persisting anti-HBs antibody levels \geq 10mIU/ml rising to 98.6% after the HBV challenge.¹¹

The main setback is the cost of these vaccines as they are not in the routine national immunization program and the parents have to pay the full cost of these vaccinations. They have been found to be immunogenic and can be administered together with the newer vaccines in the dosing schedule which allows for greater compliance and convenience for the parents.

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LEARNING POINTS

- The routine use of vaccines in the national immunization program have led to a marked reduction in incidence for these diseases.
- Tuberculosis is still endemic but BCG vaccination at birth has reduced the incidence of severe forms of disease such as meningitis and disseminated tuberculosis.
- The constant surveillance of disease prevalence and disease outbreaks have led to modifications being recommended to the national immunization program to improve protection of children from the diseases.
- Combination vaccines have been shown to be effective and have improved acceptability and compliance for the vaccinations with greater coverage of disease with fewer injections.