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Implementation of mandatory vaccinations against diphtheria, tetanus and pertussis in preterm infants as part of the Polish Immunization Programme

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ABSTRACT

Introduction: Children born before the 30 week of pregnancy, especially with extremely low birth weight, are to a large degree deprived of the protective level of antibodies normally conveyed by the mother, which makes them more prone to sepsis, pertussis, pneumococcal infections, and influenza. Preterm infants are more likely to be hospitalized due to a pertussis infection than full-term children with normal body weight. Meanwhile, the level of active prevention of infectious diseases is lower in the case of preterm infants than for infants born between the 37th and 40th week of pregnancy, since vaccinations are delayed all too often in the former group. Since 2009, preterm infants hospitalized at the neonatal ward of the University Hospital CMUJ for more than 42 days receive vaccinations against diphtheria, tetanus, pertussis and pneumococcal infections, in addition to routine BCG and HBV immunization. Active prevention of infectious diseases in preterm infants hospitalized at this ward was carried out at the Infectious Diseases Clinic that is part of St. Louis Specialized Regional Children's Hospital in Cracow. **Research material and methodology:** A group of preterm infants with birth weight below 1500 g was selected from a group of preterm infants registered at the Clinic and born before the 30th week of pregnancy in the period from September 2009 to September 2014. These criteria were met by 123 children. Fourteen children who did not receive the three doses of primary DTPa vaccinations either at the Clinic or at the neonatal wards were excluded. The gestational age at birth in the analyzed group 109 children ranged from 22 to 30 weeks, with a mean of 26.8 weeks. Birth weight ranged from 520 g to 1480 g; the mean weight was 953.4 g. The studied group of 109 patients was divided into two subgroups, the first consisted of 57 children who received their initial DTPa vaccinations at neonatal ward and the second were first administered DTPa vaccines at the Clinic. Of 109 children, only 14 (12.84%) were vaccinated on schedule. Sixty-one children (56%) received the DTPa-IPV-Hib-HBV hexavalent vaccine, while the remaining 48 children (44%) were vaccinated with DTPa. In subgroup vaccinated at the neonatal ward,

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the proportion of children who received the hexavalent vaccine was higher (73.7%) than in second subgroup, in which the polyvalent vaccine was administered to 36.5% of the children. There were no significant differences in terms of the time of the first vaccination in subgroup vaccinated in the hospital setting. However, the time of the second vaccination at the Clinic was statistically significant. Children who had received the hexavalent vaccine received the second dose earlier. Both in subgroup vaccinated at the Clinic as well as across the entire studied group, statistically significant differences in the implementation of the Immunization Programme were found to be in favor of the children who had received the hexavalent vaccine. The geometric mean levels of tetanus toxoid-specific, diphtheria toxoid-specific, and pertussis-specific antibodies as well as anti-HBs were all found to be sufficient to provide adequate protection. The children vaccinated in the hospital setting did not develop any adverse symptoms. Neither of the subgroups experienced any serious adverse events related to vaccination at the Clinic.
Conclusions: 1. Even during prolonged hospitalization at a neonatal intensive care unit, immunization with the DTPa vaccine should be performed in addition to vaccination against tuberculosis and HBV. 2. DTPa-IPV-Hib-HBV hexavalent vaccines provide an optimal solution for the implementation of immunization schedules, especially in preterm infants and – even more so – preterm infants with extremely low birth weight. 3. Results from the monitoring of episodes of apnea, bradycardia and saturation levels before and after vaccination at the neonatal ward provide valuable information to the physician that continues vaccination as part of outpatient care.

Introduction

Infectious diseases present a significant threat to the health of infants, and may even occasionally prove fatal. Epidemiological studies indicate that this age group is particularly susceptible to acute bacterial and viral infections which usually require hospitalization and treatment with antibiotics. Children born before the 30 week of pregnancy, especially with extremely low birth weight, are to a large degree deprived of the protective level of antibodies normally conveyed by the mother, which makes them more prone to sepsis, pertussis, pneumococcal infections, and influenza [1]. Another risk that is emphasized in this group of infants is the higher probability of contracting acute digestive tract infections, including rotavirus infections. The group is also at a higher risk of developing severe infectious diseases, since preterm birth is associated with certain long-term health implications, such as developmental disorders, cerebral palsy, respiratory disease, and necrotizing enterocolitis [2]. Aside from the immediate risk to health or life that these conditions present, they can also result in complications, even when treated, causing damage or permanent dysfunction of the nervous, circulatory, respiratory and muscular systems of the affected children. Preterm infants are more likely to be hospitalized due to a pertussis infection than full-term children with normal body weight [3]. A significant increase in the number of pertussis cases has been observed in Poland in the last several years, as noted in the epidemiological reports of the National Institute of Hygiene in Warsaw. While in the entire year 2014, 2102 cases of pertussis were recorded (an incidence of 5.46/100 000), the number of cases increased to 4959 in 2015 (an incidence of 12.89/100 000), and 4587 cases have already been recorded during the first eight months of 2016 (at an incidence of 11.93/100 000). It can therefore be assumed that another increase of approximately 100% will be observed in 2016 [1, 2, 4].

In the scientific community, the vaccination campaign launched by the World Health Organization many years ago is widely considered the most effective way to eliminate the afore-mentioned threats. However, the active prevention of infectious disease has sparked considerable controversy both among parents as well as some physicians, who blame vaccines or their components for the occurrence of a number of diseases diagnosed in children at later stages of development.

Immunization programs that have long been implemented in most countries treat children born between the 22nd and 37th week of pregnancy (at a gestational age of less than 259 days) as a special group. During pregnancy, preterm infants receive a lower level of antibodies that protect against infectious diseases prevented *via* vaccination than full-term children do. Higher concentrations of IgG antibodies in the circulatory system are associated with longer periods of protection from diseases. While the level of IgG antibodies in the fetus reaches 10% of the mother's level between the 17th and 22nd week, this number rises to 50% between the 28th and 32nd week. Owing to the active transport of antibodies in the final weeks of pregnancy, the infant's IgG level at birth is higher than that of the mother, especially in the case of IgG1 antibodies induced by vaccination [5]. Aside from the lower concentration of maternal antibodies, preterm infants often exhibit a reduced serological response after vaccination due to immature cellular and humoral mechanisms of immunity [6].

Depending on gestational age at birth, preterm infants can be divided into three groups. The first group includes children born between the 32nd and 36th week of pregnancy,

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