CASE REPORT

Case Study of Adverse Event Following Immunization of Diphtheria, Pertussis (Whooping Cough), and Tetanus Vaccine-Induced Encephalopathy in an Infant

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Abstract

A 4-month-old male infant was developed seizure and encephalopathy following the administration of diphtheria, pertussis (whooping cough), and tetanus (DPT) vaccine used for routine immunization. Seizure-induced by other causes was also ruled out after thorough examination of the subject using various imaging techniques. The routine immunization vaccine consists of pertussis fraction of whole-cell DPT vaccine, which is associated with neurological complications such as seizures and encephalopathy. It is advisable to use acellular DPT vaccine. Diptheria, tetanus toxoids, and pertussis vaccine is popularly known as triple antigen. It is composed of attenuated toxoids of diphtheria and tetanus as well as whole-cells of *Bordetella pertussis*.

Key words: Encephalopathy, electroencephalogram, acellular diphtheria; tetanus toxoids and pertussis, diphtheria; tetanus and whole-cells of pertussis, adverse event following immunization

INTRODUCTION

"Vaccines are the tugboats of preventive health".
– William Foege

Immunization is a process through which an infant/person will be made to immune or resistance to infectious diseases typically by the administration of vaccines at different ages of a person. Vaccines stimulate the body's own immune system to protect the infant/person against infection(s) or disease(s). Immunization is one of the most powerful tools to eradicate the communicable diseases, which cause morbidity among children. Routine vaccination saves up to 3 million children per year. 2.7 crores of children are born in India every year and around 5 lakhs children die per year because of not and/or partial routine immunization, which prevents many communicable diseases.[1] Diptheria, tetanus toxoids, and pertussis (DTP) vaccine can act against diphtheria, tetanus, and pertussis (whooping cough). It can cause serious ADRs such as hypersensitivity reaction, hypotensive–hyporesponsive shock, and post-vaccination encephalopathy.[2]

Acute disseminated encephalomyelitis, which causes due to a certain condition such as allergic, post-exanthematous, and post-vaccination.[3] The risk estimated from NCES studies for diphtheria, tetanus, and pertussis-induced brain damage is around 1 in 330,000.[4] Acute demyelination of the brain, spinal cord and following varieties of insults to oligodendroglia. Damage is periventricular in location commonly at the gray-white zone and occurs commonly after infection or vaccination usually a monophasic illness, permanent deficits after the initial severe acute manifestation of seizures, sensational alteration, raised intracranial pressure, visual disturbance with usually normal cerebrospinal fluid, mild plcocylous, slightly protein levels elevated and normal glucose. Magnetic resonance imaging (MRI) usually normal but rarely shows hypodensities in white matter and lesions.[5]

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DTP vaccine is popularly known as triple antigen. It is composed of attenuated toxoids of diphtheria and tetanus as well as whole-cells of *Bordetella pertussis*. Diphtheria, tetanus, and whole-cells of pertussis (DTwP) vaccine considered as safe, less cost, and more effective. The DTwP is preferred in many developing countries due to the generation of a higher level of antibody to pertussis toxin indicates that vaccine is more efficacy.[6] In the USA, DTP is no longer used.[7] Recently, acellular DTP (DTaP) vaccines are available in the market and referred to by the number of acellular antigen components that they contain.[6]

CASE REPORT

History

A 4-month-old male infant came to tertiary care teaching hospital located in the rural parts of the Cuddalore province, South India. The infant body weight was not according to height-weight chart; the infant was weighing around 4.75 kg as against to the expected weight 5.5 kg. It as was observed that the infant was properly immunized for the age and normal during diphtheria, pertussis (whooping cough), and tetanus vaccination. While immunization the infant was crying with immediate micturition. On the next day onward, the infant was developed with hyperpyrexia continuously for 2 days. The infant's mother managed hyperpyrexia with paracetamol all the three days. The first episode of seizure was occurred in the morning involving right upper limb lasting for 10 min with drooling of saliva from the mouth. While freedom the infant consoled, its increases the cry which was lasted for 30 min. Baby cried immediately after birth and developed roll over at 110th day and head lag with social smile at 2 months. First dose of diphtheria, tetanus, pertussis (whole-cell), hepatitis B (rDNA), and *Haemophilus influenzae* type band oral polio vaccine was administered 5th week from the birth, and successively 2nd dose was immunized at the end a 9th week from the birth no adverse event was reported. Infant mother's pregnancy was confirmed by HCG test; she was adequately immunized. No history of gestational diabetes mellitus, pregnancy-induced hypertension, quickening felt at 5th month. It was a normal vaginal delivery with episiotomy.

The baby was brought to the hospital for administering the third dose of immunization and immunized, but after 1 h following the immunization reported for adverse event. The patient was admitted with the following complaints: Trauma, loose stools, up rolling of eyes, deviation of angle of mouth, ear discharge, and neck stiffness. In history, there were no similar complaints during the time of birth. On clinical examination of infant showed allergic reactions, inactive, open in anterior fontanelle, non-pallor, cyanosis, icterus, edema, and no other abnormality were observed. Color of the baby was become pink and decreased cry activity with poor central nervous system reflux and tone. 152 beats/min of heart rate with 40 beats/min respiratory rate. Table 1 provides the actual and referred values and ranges of clinical parameters present in the subject. It was measured during the admission of the subject at first visit to the hospital.

Treatment

The treatment was initiated after ruling out of seizure induced by other causes, and there were no abnormal signs were observed from the computed tomography and MRI scan reports. Treatment was started immediately with intravenous (IV) isolate – P475 ml/24 h, injection ceftriaxone 250 mg IV at 12th hourly, injection Vitamin K 2 mcg/day, syrup paracetamol (125 mg/5 ml), and hydration therapy for 6 days and convulsions were monitored. On the 3rd day after admission, the baby was developed with a high-grade fever later brought to normal body temperature with tepid sponging and medication. After 2 days, the infant was alert, afebrile, active, heart rate was 86 beat/min with respiratory rate 24 beat/min. The patient was discharged on 6th day. The discharge medication advice was provided. The discharge medication includes cefixime drops (25 mg/ml) 0.8 ml at every 12th hourly, syrup phenytoin (30 mg/5 ml) 4 ml at night for 15 days.

DISCUSSION

In general, DTP is recommended to administer at the age of 6th, 10th, and 14th weeks of birth as between 16 and 24 months and from 5 to 6 years. The government of India was initiated Universal Immunization Programme (UIP) during 1978, which is one of the largest and successful in the world. UIP was covered cross the entire country, organization of repeated number of immunization, about 80% of the pediatric population got benefited, and quantities of vaccine were also huge.[8] The Government of India bears the cost of all vaccines except for pentavalent vaccines. The pentavalent vaccines were dispensed at a subsidiary price.[9] Due to the UIP, Indian government was eradicated some communicable diseases, e.g., polio.

Table 1: Laboratory report

Investigation	Value	Normal range
Serum sodium	144 mmol/lt	136–145 mmol/L
Serum potassium	4.7 mmol/lt	3.5–5.0 mmol/L
Serum chloride	102 mmol/lt	96–106 mmol/L
Serum creatinine	0.8 mg/dl	0.6–1.2 mg/dl
Hemoglobin	11.5 g/dl	14–18 g/dl (males) 12–16 g/dl (females)
RBC	1.48 million/mm^3	4.8–7.2 million/mm^3
Subdural CSF		
Sugar	84 mg/dl	45–75 mg/dl
Protein	29 mg/dl	15–45 mg/dl
Chloride	127 mg/dl	120–130 mg/dl

RBC: Red blood cell, CSF: Cerebrospinal fluid

Adverse event following immunization (AEFI) is any unintended event after the immunization, which may or may not be caused following vaccination. The adverse event may be any unfavorable or unintended signal or abnormal laboratory reports or symptoms.[10] The AEFI is induced three factors: (i) Vaccine reaction, (ii) program error, and (iii) psychological behavior. The AEFI is classified into five types as: (i) Vaccine reaction, (ii) program error, (iii) psychological behavior, (iv) not due to injection but may be interaction other factors like diseases, and (v) unknown causes.[11]

There are many case reports have shown that vaccines contain DTwP antigens may cause encephalopathy. After the administration of DTwP vaccine, it may cause mild and severe adverse events. The mild events may vary from local and/or systemic reactions such as mild fever, drowsiness, loss of appetite, and vomiting,[12] whereas the severe events may lead to high-grade fever, persistent crying, seizure, hypotonic-hyporesponsive episode, encephalopathy, severe myoclonic epilepsy of infancy (Dravet's syndrome), anaphylaxis, and very rarely brachial neuritis.[2,12-18]

CONCLUSION

Based on our findings, it is concluded that the encephalopathy was induced after the administration of DTwP vaccine. Moreover, the early recognition of encephalopathy is of paramount importance for initiating appropriate management to prevent further complications, and timely diagnosis will help to start the therapy to recover fully from the seizure effects. On the use of acellular diphtheria, tetanus, and pertussis (DTaP) vaccine instead of traditional whole-cell vaccine (DTwP) post-immunization adverse events including encephalopathy can be avoided.

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