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# Polio Vaccination at Birth: Current Status and Future Perspectives

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## ABSTRACT

**Introduction:** In the 1950s, Poliomyelitis was a dreaded disease which crippled millions of children all over the globe and a public health scare even in countries where the best health systems existed<sup>1</sup>. Almost all children infected with polio developed paralytic poliomyelitis.

**Aim:** This review aims to systematically review the published literature regarding the use of OPV and IPV at birth to determine;

i) The justification for an additional dose of tOPV at birth.

ii) The use of bOPV in place of tOPV.

iii) The use of IPV in place of OPV.

**Conclusion:** The lack of robust data at present does not recommend the birth dose of IPV in countries using IPV in their routine immunization schedule or any other countries.

**Key Words:** OPV (Oral Polio Vaccine), IPV (Inactivated Polio Vaccine), VAPP (Vaccine Associated Paralytic Poliomyelitis), cVDPV (Circulating Vaccine Derived Poliovirus)

## INTRODUCTION

In the 1950s, Poliomyelitis was a dreaded disease which crippled millions of children all over the globe and a public health scare even in countries where the best health systems existed<sup>1</sup>. Almost all children infected with polio developed paralytic poliomyelitis. Poliomyelitis, an acute paralytic disease is caused through 3 poliovirus serotypes, type 1, 2, and 3. 25,000 to 50,000 new cases occurred in each year. To combat this menace an American Physician, Jonas Salk developed the first-ever polio vaccine known as the Inactivated Polio Vaccine or Salk Vaccine in the early 1950s. The vaccine was a killed vaccine and given by injection. An oral live attenuated poliovirus vaccine was introduced by another American Physician Albert Sabin in the early 1960s. Both these vaccines contain all three variations of poliovirus strains. Oral Polio Vaccine (OPV) has been the cornerstone of eradication efforts in endemic countries, using it as the vaccine of choice in mass immunization programmes. It provides superior mucosal immunity against subsequent infection and spreads vaccine to closer contacts, thereby

immunizing the children who could not be reached by immunization programmes. OPV has multiple licensed formulations, i) Monovalent OPVs against type 1 (mOPV1), type 2 (mOPV2) or type 3 (mOPV3) ii) Bivalent OPV (bOPV) containing type 1 and 3, and iii) Trivalent OPV containing type 1, 2, and 3 (tOPV)<sup>2</sup>. It was reported that tOPV is associated with rare cases of VAPP (Vaccine-associated paralytic poliomyelitis). According to a recent review, the global risk is estimated to be around 4.7 per million births (range 2.4-9.7)<sup>3</sup> and approximately 2-4 cases per 1 million in a birth cohort in developing countries<sup>4</sup>. Another major adverse event associated with OPV is cVDPV (circulating vaccine-derived poliovirus) which arises due to mutation and recombination with other enteroviruses in the human gut and are usually 1-15% divergent from the parent vaccine virus<sup>5</sup>.

WHO has recommended administration of one supplementary dose of OPV at birth in emergent countries similar to India since 1985 where host reaction to the standard three-dose schedule at 6, 10 and 14 weeks is not acceptable as well as poliomyelitis continues to be a health crisis<sup>6</sup>. The OPV

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administration at birth can provide the earliest protection to the newborns in endemic settings and maybe the only vaccine the child may receive as there is every chance that the child may be lost and may not get any further vaccine. Since most newborns have maternally derived antibodies against poliovirus one supplementary birth dose of OPV is associated with the lowest risk of developing VAPP.

## AIM

This review aims to systematically review the published literature regarding the use of OPV and IPV at birth to determine;

- i) The justification for an additional dose of tOPV at birth.
- ii) The use of bOPV in place of tOPV.
- iii) The use of IPV in place of OPV.

## Review of literature

- a) tOPV as birth dose:-In one RCT among 452 infants conducted by Osei-Kwasi M et al.<sup>7</sup>(1995), the infants conventional tOPV in the company of or without birth dose level of poliovirus neutralize antibodies, as well as seroconversion rates, were consistently higher among those getting birth dose. For the test group, the seroconversion rates for type 1, 2 and 3 were 83.5%, 91% and 83% respectively and for the control group, it was 75%, 83.2% and 79.5%. Likewise in another study conducted by Bhaskaram P<sup>8</sup>(1997) it was shown that administration of a birth dose of OPV induced significantly higher amount of systemic and mucosal immunity conferring immunity at an early age. Khare<sup>9</sup> in study conducted in 1993 compared the seroconversion rates among infant who was given one dose of OPV on 3<sup>rd</sup> day after birth and the conventional 3 dose schedule starting at 6 weeks of age and the other group of infants who received the conventional 3 doses only. The study showed that the administration of OPV on 3<sup>rd</sup> day after birth led to seroconversion in 15.3% to poliovirus type 1, 2, and 3 by 6 weeks and highest zero response was noted for type 1. Seroconversion in the 1<sup>st</sup> group was considerably higher after the administration of the last dose. Weckx Ly<sup>10</sup> in a study conducted in 1992 evaluated the neutralizing antibody response of tOPV among 85 neonates. Group A was given tOPV at birth, 2, 4 and 9 months of age and Group B received at 2, 4, and 6 months of age. Better response to type 3 was noted in Group A. After 1 year there were 3.7% lacking neutralizing antibody in Group A and 25.9% in Group B. outstanding seroconversion rates were shown in Group A from 3<sup>rd</sup> dose onwards. Bhatawdekar AM<sup>11</sup> (1990) conduct a study of 68 infants. Group A consisting of 47 infants were given tOPV within 4 days of life and at 1 and 2 months whereas Group B of 21 infants was administered at 3, 4

and 5 months. The seroconversion for type 1, 2 and 3 in Group A was 87.2%, 95.7%, 72.3% respectively and Group B 85.7%, 95.2%, 66.7% respectively. He concluded that the difference was unimportant. De-Xiang D<sup>12</sup> (1986) in a study conducted in China among 200 healthy neonates showed that antibodies, after the 4<sup>th</sup> dose, were exhibited in almost 100% neonates. 8.2% excreted poliovirus for at least a week after the initial dose which improved to 99% after the 2<sup>nd</sup> dose. They concluded that immunization of neonates at the initial age-induced immunity to poliovirus.

- b) bOPV as birth dose:-Sutter RW<sup>13</sup> (2010) in a study in India evaluated the immunogenicity of bOPV compared to tOPV and demonstrated that seroconversion rates to poliovirus type 1 and 3 following immunization with bOPV were significantly higher than those induced by tOPV. Mangal TD I<sup>14</sup> (2014) in a study in Nigeria showed that against serotype 1 bOPV has higher clinical efficacy. Sutter RW<sup>15</sup> in another study in 2015 demonstrated that a schedule of bOPV at birth, 6 weeks (tOPV or bOPV), 10 weeks (tOPV or bOPV) and 14 weeks (bOPV with or without IPV) showed excellent immunogenicity to poliovirus type 1 and 3.
- c) IPV as birth dose:-Sutter et al.<sup>16</sup> (1997) studied sequential use of IPV followed by oral vaccine. The study verified no difference in seroprevalence and titers between birth dose or no birth dose. Jain et al.<sup>17</sup> (1997) in a study on Indian neonates demonstrated that a significantly greater number of children receiving some vaccine (IPV or OPV) at birth were protected against poliomyelitis by 6 weeks of age as compared to those receiving no immunization at birth. They concluded that seroconversion rates following 3 doses of IPV are satisfactory. Addition of an extra dose of IPV or OPV at birth significantly increases seroconversion rates. Morteem et al.<sup>18</sup>(2013) evaluated the seroconversion and report adverse events if any among infants given a single birth dose (given <7 days of life) of IPV or OPV through a systematic review of published articles and conference abstracts from 1959 to 2011. They reported great variability of the immunogenicity of a birth dose of OPV for reasons chiefly unidentified. The study established the efficacy of a birth dose of OPV predominantly in countries wherever the most primitive development of immunity next to poliomyelitis is need of the hour. Sero conversion from a newborn dose of IPV was studied only in 4 studies. IPV has superior conversion rates in newborn and maybe a better choice in countries which can afford the cost. However, more studies are essential in this area. No unfavourable events were reported in the study.

Following the deliberate global exchange from tOPV to bOPV in April 2016, tOPV is no longer used in Routine Immunisation Schedules. Thus bOPV having superior conversion rate is the choice.

## CONCLUSION

Though there is no uniformity in seroconversion rates following a birth dose, other reasons suggest continuing with a birth dose. WHO June 2010 position paper<sup>19</sup> endorsed to continue the birth dose. WHO recommended one dose of polio at birth or as soon as possible after birth to increase the seroconversion of consequent doses and to provoke mucosal protection before interference by enteric pathogens with the immune reaction. Besides, the first bout of OPV, given at a time as soon as infants are beneath the protection of maternally derived antibodies, may avoid VAPP. OPV birth dose is not obligatory in countries where the risk of in their natural habitat poliovirus transmission is low. The lack of robust data at present does not recommend the birth dose of IPV in countries using IPV in their routine immunization schedule or any other countries.

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