Lessons from a small outbreak of poliomyelitis

The campaign to eradicate poliomyelitis, a paralytic viral neuroinfection, launched by the World Health Organization (WHO) in 1988, resulted in the drop of the disease incidence from several hundred thousands cases per year to less than one hundred in 2015. This was due to the use of the Salk inactivated polio vaccine (IPV) and the Sabin live oral polio vaccine (OPV). Both vaccines, being very efficient, possess some drawbacks. The IPV does not generate the intestinal immunity and therefore cannot prevent circulation of the virus, whereas OPV inflicts, though extremely rarely, the disease in the vaccinees and their contacts and also may circulate among non-immune persons and acquire pathogenic genetic changes. Thus, two kinds of OPV-associated poliomyelitis are distinguished; those caused by the original or slightly changed (Sabin-like) OPV, on the one hand, and those due to evolved, i.e., accumulating markedly more mutations, vaccine-derived polioviruses (VDPV), on the other. The Sabin-like viruses were known until recently to trigger only sporadic (isolated) cases of the disease (dubbed as vaccine-associated paralytic poliomyelitis, VAPP), whereas VDPV can prompt also more or less large epidemics. Therefore only the VDPV-caused diseases are considered to require broad-scale epidemiological responses. The borderline between the Sabin-like polioviruses and VDPV is however blurred by our observation of a small outbreak of poliomyelitis caused by a Sabin-like virus, which occurred in 2010 in an orphanage of Biysk (Russia). This is not a merely semantic issue, since the lack of substantial differences means that the both situations may demand similar epidemiological responses.

This outbreak demonstrated several additional unusual features. It is known that less than 1% non-immune persons infected with wild polioviruses are paralyzed, whereas the incidence of VAPP is several orders of magnitude more rare. There were slightly over one hundred children in the Biysk orphanage (most being previously vaccinated with IPV and therefore unsusceptible to poliovirus) and four of them, all not vaccinated, developed VAPP, being infected with the Sabin-like virus circulating in this institution. This gives an exceptionally high ratio between the numbers of those who were paralyzed and those who were non-symptomatically infected. In this unique case, this ratio for a Sabin-like virus was much higher than even for the wild polioviruses. In principle, scientists know what genetic peculiarities distinguish wild (virulent) polioviruses from their attenuated (vaccine) counterparts. However, determination of the complete sequence of nucleotides in the RNA genomes of Biysk viral isolates did not give us any clues to understanding their exceptional pathogenicity. These (and some other) our observations underscore the existence of important gaps in the understanding of pathogenesis and epidemiology of poliomyelitis.

This outbreak has significant implications for the current battle against poliomyelitis. To eliminate the incidence of vaccine-associate poliomyelitis, WHO is planning to completely switch from OPV to IPV, and the use of the Sabin vaccine of serotype 2 (the serotype causing the Biysk outbreak) is already canceled from April 2016. On the one hand, the Biysk outbreak may be an argument in favor of such plans, since it provides additional evidence for the risks associated with the use of OPV. On the other hand, this outbreak demonstrates a significant hazard associated with the existence of even relatively small non-immune cohorts within IPV-immunized populations

(remember, IPV cannot prevent transmission of poliovirus). In our view, the optimal solution would be the replacement of OPV (and, OPV of serotype 2, in particular) by a safer live or non-live vaccine(s) able to mount intestinal immunity, rendering its recipients unsusceptible to the infection and making them unable to be carriers in the still existing chains of poliovirus transmission. Several teams are now attempting to develop such vaccines.

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