From Jenner to modern smallpox vaccines

Edward Jenner, born in 1749, grew up in Berkeley, Gloucestershire, and pursued his interest in medicine in London where he became a student and lifelong close friend of John Hunter the anatomist and surgeon. Jenner returned to Gloucestershire in 1772. At that time, smallpox was an infectious scourge affecting mainly children. Most who reached adulthood had been exposed to the disease with a case fatality rate of 10–20%, though much higher in epidemics. Jenner was aware of local country lore that milkmaids who acquired cowpox lesions during milking were resistant to infection with smallpox. In 1796 he took material from a cowpox lesion of Sarah Nelmes, a milkmaid, and inoculated it into the arm of a young lad, James Phipps subsequently variolating both arms of the unfortunate Phipps (not once, but twice).

Amongst others, a Dorset farmer, Benjamin Jesty, had done something similar 20 years earlier, but Jenner was the first to realise the importance of his experiment and its public health potential. After a series of further ‘vaccinations’, he published his findings in 1798 in the ‘Inquiry’ provoking immediate interest in Britain, Europe and the New World.

Smallpox continued to cause endemic and epidemic disease in the 19th and early 20th centuries, gradually coming under control through widespread use of vaccination, improvement in public health and the isolation of smallpox patients. In 1967 the World Health Organization set up a unit headed by Donald Henderson with the objective of global elimination of smallpox. Forty-four countries reported a total of just over 130 000 cases although the true figure was probably closer to 10 million. Despite many setbacks, smallpox was eradicated by 1979, with the last naturally occurring case documented in Mogadishu, Somalia, in 1977. Routine smallpox vaccination ceased shortly thereafter, at a global saving of many millions of dollars.

With almost no use of the smallpox vaccine for the last 40 years, the world population is thought to be highly susceptible to smallpox giving rise to concern that the virus could be used as a biological weapon. The USA has promoted the development of a new generation of smallpox vaccines, stating its intention to hold sufficient stocks to vaccinate the entire US population in the event of a deliberate smallpox release.

There are at least five new smallpox vaccines in development, as well as possibly 100 million doses of the traditional vaccine. The safety profiles of the new vaccines when used in large populations have yet to be determined but are likely to be better than those of the traditional vaccines. Mathematical models have been used to predict the possible spread of smallpox in various different release scenarios as well as to inform debate on how best to use both the traditional and new vaccines. Planning is influenced by the risk perception. If the risk is low, then it is best to keep new vaccines in reserve and deploy only in case of need. If the risk is high, a universal vaccination programme might be justified with inevitable morbidity and mortality. In the UK currently the strategy is to hold vaccine in reserve but protect those healthcare workers tasked with triaging and managing possible cases of smallpox. Whether any groups with evil intent towards the UK could access viable smallpox preparations and mount a credible threat remains a matter of conjecture.

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References