Smallpox

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Abstract

Smallpox is an acute and contagious disease that is caused by the variola virus. It manifests as one of three strains including variola major and minor as well as *variola sine eruption.* Researchers are unsure about the origin of the virus that causes the disease, but the most probable explanation stems from the rodent theory proposed by the World Health Organization. Additionally, smallpox is speculated to have originated from Egypt. The disease life cycle lasts through six stages, during which the infected person is contagious apart from when it is in the first and last phases. Smallpox was mainly transmitted from long term face to face exposure, and contact and its eradication is attributed to the discovery of variolation. Since its elimination, live strains of the variola virus are available in research facilities to promote further studies on the disease, a factor that creates the possibility of the use of smallpox for bioterrorism attacks.

Smallpox

Smallpox is a contagious and acute disease caused by the variola virus. It has two clinical forms, variola major and variola minor. The variola major type of smallpox was the most prevalent and the most severe strain that was characterized by higher fever and a pervasive rash. The variola minor clinical form of the disease was less frequent and less severe with the death rates thereof being less than one percent. Additionally, apart from the two clinical strains of the virus, there was a third form called *variola sine eruption*, which manifested in people that had been vaccinated, who did not get the rash that characteristically distinguished smallpox infection. The third strain of the disease was detectable by a fever that would affect the infected patients after the usual smallpox incubation period, and to confirm their diagnosis, antibody studies had to be undertaken (Weiss & Esparza, 2015). To date, smallpox is considered the most devastating disease to affect humans, and its last natural case was recorded in Somalia in 1977. A global immunization campaign spearheaded by the World Health Organization (WHO) resulted in the eradication of smallpox, evidenced by the 1980 elimination declaration (WHO, 2019). Despite successfully combating the existence of the disease globally, the risk of its re-emergence remains unpredictable.

Origin of Smallpox

Researchers are not sure about the origin of the variola virus that caused smallpox. Ochmann and Roser (2016) indicate that WHO offers two origin theories, one of which suggests that the form of the variola virus that infected humans was from rodents that lived 16000 to 68000 years ago. The other speculation promulgates that the mutation of a proto-variola caused the epidemic, which is now referred to as smallpox. Since the variola virus has remained distinct from others in the orthopoxvirus family over the last three thousand years, the most viable explanation of its origin is the rodent theory. Furthermore, epidemiological studies hypothesize the source of the variola virus based on the fact that it predominantly

affected humans, highlighting its dependence on the large human population that could continuously provide hosts to facilitate its survival. Infected humans would either die or survive and become immune for the rest of their lives.

It is speculated that since Egypt was home to one of the earliest human civilizations about 3000 years ago, the country could be the source of various illnesses, including polio and smallpox. Archaeological evidence supports the hypothesis considering the recorded findings of “dome-shaped vesicles,” similar to those caused by smallpox, on the skin, bones, and muscle of mummies, owing to the Egyptian mummification practice (Ochmann & Roser, 2016). Thus, despite the unclear origin of the disease, smallpox affected individuals across the globe, resulting in devastating life loss.

Stages of Smallpox Infection

Upon infection by smallpox, the first stage of the disease, is the incubation phase which can last anywhere between 7-19 days, during which the individual is not contagious. Within the mentioned period, the virus remains in the person’s body, but they do not feel or look sick. After incubation, the initial symptoms of the disease begin in the second stage, which can last anywhere between two to four days. During the initial symptom phase, smallpox is likely to be contagious but not all the time. Among the symptoms that an individual will exhibit are body and headaches, high fever, and occasional vomiting. The early rash stage follows, during which the person is highly contagious. The phase lasts for about four days, characterized by a rash that starts as a small red spot in the month or on the tongue. The spots become sores that rapture and spread the virus in the throat and mouth. When the wounds in the mouth breakdown, a rash appears on the skin, first on the face, then on the legs and arms, after which the hands and feet follow. The spread of the outbreak happens in about 24 hours, and rash appearance results in lower fever compared to what the person has experienced previously. Within the four days, the sores on the skin fill up with

opaque and thick liquid and are dented in the centre. The filling of the lesions may cause the fever to rise again and remain the same until scabs are formed over the bumps (CDC, n.d.). Past the third phase of smallpox infection, the self-healing process is initiated.

Scabs and pustular rash characterize the fourth stage of infection, which lasts for about ten days. The infected party is contagious, and sores that become pustules portray the signs of infection. In five days, the pustules create a crust and become a scab. By the second week of the appearance of the rash, most sores become scabs. Next is the scab fall off phase, which lasts about six days, during which the infected party is contagious. As the scabs fall, they leave marks on the skin and in most cases, three weeks after the appearance of the rash, the blisters are expected to have fallen off. Finally, the no scab phase sets in when the person is no longer contagious (CDC, n.d.). It is important to note that as long as the scabs remain on the skin of the infected party, the individuals are contagious.

Transmission of Smallpox

Before the eradication of smallpox, it was primarily transmitted through prolonged and direct face to face contact with infected persons. A smallpox patient could pass the disease to others once the sores started appearing on their throat and mouth in the early rash stage of the disease. A carrier spread the virus by coughing or sneezing when the droplets from their mouth or nose fell on other people, and they were contagious until the last disease scab fell off. Additionally, the blisters and the fluid in the sores on the patients' skin contained the variola virus, and objects, such as clothing or beddings, contaminated by either would cause the spread of the disease. Thus, the caregivers of smallpox patients had to wear gloves when cleaning the patients' clothes and beddings to avoid infection. In rare cases, the airborne variola virus spread through the air, resulting in a secondary infection. Scientific research shows that smallpox can only be passed from one human to another with no evidence suggesting that the disease can be spread by animals or insects (CDC, n.d.).

Provided one avoids direct contact with an infected party; it is highly likely that they will remain uninfected.

The Achievement of the Eradication of Smallpox

Eradicating smallpox was initiated by the discovery of variolation, a process that involves deliberately transmitting viral matter. Before the year 1000, the Chinese and Indians had discovered that contracting smallpox protected individuals against future outbreaks, a factor that led to the development of the nasal dried scab inhalation procedure undergone by three-year-olds within their communities. In other cases, the liquid in the pustules of patients infected with smallpox was injected under the skin of healthy people, causing a milder infection that would make them immune to the disease. However, variolation proved to be an inefficient means of controlling the disease because once mildly infected, the person could become a contagious smallpox carrier. Moreover, it was hard to control the severity of the infection, and in some instances, it developed into full-blown smallpox, which resulted in the death of the infected (Henderson, 2011). Hence, the variolation technique only reduced the severity of smallpox infection but never led to the elimination of the virus.

The development of a smallpox vaccine was pioneered in the 18th Century by a British surgeon named Edward Jenner who discovered that the variola and cowpox viruses belonged to the orthopoxvirus family. The medical professional hypothesized that variolation using the cowpox virus would ensure the protection of children against smallpox infection. In 1796, Jenner injected a boy with cowpox and in a few months with the smallpox virus. When the boy did not develop any smallpox symptoms after variolation, the doctor’s presumption of cowpox protecting from smallpox was affirmed, and it motivated further research. In 1802, England acknowledged Jenner’s crucial contribution and his solution for smallpox facilitated the reduction of the disease’s prevalence in Britain and consequently, other parts of the world (Liebowitz, 2017). Considering the devastation that had resulted from the smallpox virus

infection, Jenner's vaccine invention may be termed as one of the most critical developments in healthcare history.

Research since the Eradication of Smallpox

After the elimination of the smallpox virus, a sophisticated debate on the destruction of the remaining stocks of live variola ensued. The remaining samples of both strains of the variola virus were restricted to 2 laboratories, which are run by WHO and are located in the United States and Russia. Further deliberations resulted in the decision to eliminate all live samples of the virus, including those in the named laboratories in 1996. In 1999, there was no consensus on the issue of the destruction of the variola samples, with their retention being authorized for further research purposes (WHO, 2019). Though their access is restricted, the possibility of falling in the wrong hands cannot be ignored.

The existence of the smallpox virus makes the possibility of the use of variola in a bioterrorist attack possible. Therefore, to prepare for the unlikely event, public health officials have readied measures that can be taken in terms of informing the American public about a smallpox outbreak and access to emergency vaccines. The Centre for Disease Control contributes to the named efforts by researching new treatments, storing drugs and vaccines, planning effective responses, and educating healthcare professionals (CDC, n.d.). Preparation is the surest way of enhancing the readiness to deal with smallpox in case it surfaces in the future.

Conclusion

The smallpox virus has devastated the global population once before, and since the disease pathophysiology is already known, it is imperative that healthcare professionals and governments collaborate to realize measures that can facilitate the control of the disease if it breaks out again. Moreover, Jenner's invention of the vaccine served as a hallmark within the

healthcare industry in the fight against smallpox, but further research to develop better remedies is encouraged.

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