

Medical treatment —————

Do Infectious Diseases Belong to the Past? — Looking back on the History of Epidemics

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In modern Japan the most common causes of death for the nation are the three major adult diseases, i.e. cancer, myocardial infarction, and stroke, therefore these diseases are considered as important in the present medical care. It is, however, only recently that we are in this situation; the human beings had historically suffered so-called "epidemics" (i.e. infectious diseases) throughout all ages. Have the epidemics disappeared in the contemporary time of advanced medical science and are they no longer a threat to mankind? Here in this article, I am going to review two epidemics which terrified the human beings and even changed the history, and consider the potential issues that may arise in the future.

Part 1. The Blue Wolf in the Plains and "The Black Death"

In the 13th century the Mongol Empire, having risen from the steppes in the Central Asia lead by Genghis Khan, conquered the surrounding countries one after another by their overwhelming strength and mobility, which resulted in the foundation of an unprecedentedly enormous empire ruling the entire Eurasia.

In 1253 the Mongolian armies commenced a military operation in Yunnan, a region near the current border of China and Myanmar. This area, accidentally, was a habitat of the burrowing rats which harbored *Yersinia pestis* in their bodies under ordinary conditions. The Mongolian soldiers, totally unaware of the fact, went on the rampage in the region and returned home. As they moved, probably, the rats and the fleas which were parasitizing the rats' bodies also migrated to the steppes in Mongol hidden inside the horses and the food. Subsequently, the place of living for the rats harboring *Yersinia pestis* stretched over the vast steppes in Eurasia, which led to an outbreak of the plague initially in China over the 14th century decimating the population nearly by half from 123 million in 1200 before the Mongolian-invasion to 65 million in 1393 after the collapse of the Yüan dynasty. The plague, furthermore, began to move toward the west carried by the flow of the Muslim merchants, who traveled down the extensive network of caravan roads built under the reign of the Mongol Empire, and the cavalries who journeyed

faster. In the desert oases where a lot of people and camels gathered, there were food storages to feed them, which offered ideal feeding grounds for the rats. Thus, an environment where *Yersinia pestis* could live comfortably was established among the rats and the fleas inhabiting their bodies—all set for extensive spread to humans if prompted by a trigger.

Consequently, as the plague was travelling toward the west, it reached the trading town of Kaffa on the coast of the Black Sea in 1347. The plague, which broke out suddenly among the Mongolian armies who had sieged the town, spread in the town of Kaffa. The Italian merchants who had been engaged in trading activity in the town fled in disorder on their boats and arrived at the port of Messina, Sicily at one night in October. Soon, they would see the first patient infected with the plague in Messina, and then from the whole land of Sicily, the disease quickly began to go up north over the Italian Peninsula. While sweeping the South of France and the Iberian Peninsula, it went the other way to Austria, Switzerland, and South Germany. In 1349 the plague reached England and the northern part of Germany, resulting in one-third or a half of the European population decimated in only five years; this is the episode well-known as "The Black Death" in the medieval Europe.

Consequences of the Epidemic

Even in this age when people had no knowledge of bacteriology, they attempted to reduce the danger of infection by implementing the idea of "isolation and quarantine," for which the ships entering the ports along the coast of the Mediterranean Sea were required to be isolated for 40 days. Although it was not very effective, the idea itself was not incorrect (a similar approach was taken at many ports around the world at the time of the outbreak of influenza in 1918).

In the 19th century, the area infected with the plague, which, up to then, had been confined within Eurasia and Africa to the south of the Sahara, stretched to the New World (North and South America and Australia). This pertained to the development of the motive power of ships which made swift voyage possible. Even if there are infected persons on a ship, all hosts are to die out if the voyage takes a long time as the bacilli are neutralized (which must have been true in the age of sailing ships). It was not until the era of mechanical ships that the rodents in the New World became carriers of *Yersinia pestis*. The period saw the third outbreak of the plague which spread over most of the entire world. This time of preantibiotic era, however, the human beings had knowledge of bacteriology, which enabled them to identify the infection routes of the disease and implement effective prophylaxis.

Today, in many parts of the world, *Yersinia pestis* parasitizes the rodents such as wild rats and squirrels and some of these areas are dangerous as the human beings may also be infected. According to the WHO, the incidence of the plague is

increasing over the last few years and approximately 1,500 cases are reported every year mainly in the regions such as India, Africa to the south of the Sahara, and the western United States.

In modern times the plague is no longer a devastating disease because we are able to perform vaccination and we also have effective antibiotics. However, belated diagnosis may still result in a fatal condition and it has also been reported that drug-resistant *Yersinia pestis* (to which antibiotics are ineffective), as seen in many other bacteria, was identified in Madagascar, presenting a possibility that the same nightmare may recur. The elements necessary for an outbreak of the disease, i.e. rats, fleas, and humans, are readily existing all the time.

Part 2. Tragedy of the Tribe of the Sun

In 1519 a Spanish man, Hernán Cortés, landed in the Yucatan Peninsula with only 500 soldiers, 50 guns, and 16 horses and conquered the Aztec Empire, which had tens of millions of population. How on the earth could it be possible? Obviously the Aztecs must have scared the guns and they should have been frightened by the horses (as large mammals like cattle and horses originally had not inhabited the New World). Nonetheless, the guns at that time were not so different from the matchlocks used in the age of provincial wars in Japan, therefore it could have been fully possible for the Aztecs to mount a massive counterattack with arrows and spears if they chose to. Although there is common belief which attributes the reason for the Aztecs' allowing the conquest so easily to the fact that they believed the Spanish to be reincarnation of the God, Quetzalcoatl, it does not provide sufficient reasoning.

In fact, it was not a runaway victory throughout the process for the Spanish—Cortés was once forced to retreat from the capital city of Tenochtitlan. Having beaten the enemy, the Aztecs must have been excited with delight, suddenly, a terrifying epidemic broke out among them. The name of the disease was smallpox—the only epidemic that has now been eradicated from the earth. Even before the outbreak befell the Aztecs, smallpox had already been a frightening epidemic in any other countries, killing a large number of people once it spread. To the people in the New World, however, smallpox was a totally new disease, which means that the population there completely lacked immunity to the disease; this usually leads to a catastrophic situation (where the infection rate and mortality become devastatingly high). In the case with the Aztecs, as many as approximately one-third of the population was decimated by the disease. Furthermore, an outbreak of measles followed during a period from 1530 through 1531, which also killed a large number of people. Subsequently, the diseases which were, though frightening, familiar to the people in the Old World—such as influenza as well as diphtheria and epidemic parotitis (mumps)—swept the New World one after another and

reduced its population to one-tenth, from the original population supposedly totaled to approximately 100 million, in a little over 100 years.

Here, some may wonder if, while there were diseases which were transmitted by the Spanish, there were no diseases that were transmitted conversely by the people in the New World. For instance, the French who endeavored to build the Panama Canal in the 20th century had to withdraw from the site because they lost many workers due to malaria. Why didn't Cortés and the Spaniards suffer the infectious diseases which are specific to the tropics such as malaria and yellow fever? The answer is simple; these diseases did not exist there at first. Since too many natives died following the Spanish conquest, they had labor shortage and began to import the Africans as slaves. At the same time, they loaded the mosquitos which transmit malaria and yellow fever on the slave ships from Africa.

Soon after the incident of the Aztecs, the Inca Empire, also located in the South America, was destroyed by a small group of the Spanish, at which time, similarly, smallpox spread from the north over the land, infected the Inca (meaning the Emperor) and killed him, causing conflict for a successor, which was used by Pizarro and his men to their advantage and the empire was conquered without effort.

The series of events clearly shows the size of deaths due to an infectious disease when people encounter it for the first time with no immunity whatsoever to it. In the Old World in the period before the Common Era, along the historical process in which various tribes fought each other in armed warfare or thrived through amicable exchanges such as trading, people also shared even infectious diseases. This left immunity in the bodies of the people in the Old World, or, they accumulated wisdom to prevent endemic infections by means of customs in social life established from experience; through such a process over a long time, many infectious diseases became no longer a great threat. To the contrary, from a viewpoint of infectious diseases, the New World was merely like a huge island where people had no opportunities to obtain immunity by way of sustaining various diseases. This seems to be the fundamental reason that the two empires of the Aztecs and the Inca were conquered so easily by a small number of Spaniards. Had the people in the New World had immunity to smallpox, or had any epidemics which were fearful to the Spanish but familiar to the natives already existed there, Spain could have failed to conquer the New World and the subsequent world history might have been totally different.

Consequences of the Epidemic

As vaccination was discovered in the 19th century and its use spread extensively, smallpox disappeared from the world. Finally in 1980, the WHO declared eradication of smallpox, which may be considered as an outstanding victory in medicine; it is no wonder that people expected many infectious diseases

to disappear from the world. In fact, however, it has not turned out so—for instance, even measles, which we should be able to eradicate, is still prevalent in Japan.

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Considering the above two stories, we come to realize that some conditions are required for large-scale infections to develop. The first is overcrowding. Others would include that the population in the area has no immunity to the disease, and that there is (large-scale and swift) traffic of people and animals that can transmit diseases. We may apply these to the modern society—the population has grown to the largest ever; we can arrive at anywhere on the earth within 2 days by airplane and a number of people are flying around on business or holiday. From a standpoint of pathogenic microorganisms, this situation offers them an ideal environment.

To the pathogenic microorganisms, the problems that didn't exist in the past but are now present are vaccines that boost the human immune system, and the antibiotics and antiviral drugs used in the treatment after they successfully caused infection. It is these two means that can be the ultimate countermeasure for the modern medicine to confront infectious diseases.

What if, however, a new type of infection erupted?—please recollect, for example, SARS in 2003, or novel influenza A (H1N1) in 2009, which is still fresh in our memory. For SARS, initially no pathogen or no infection routes could be identified, therefore the classic "isolation and quarantine" approach (as seen in the outbreak of the plague in the Middle Ages) was the only possible countermeasure we could implement immediately. In the case with novel influenza A (H1N1), it took so long to manufacture an enough number of vaccines that people could only practice what they were usually told, such as gargling, washing hands, or avoiding crowds. As the latest bird influenza H7N9 demonstrated, under a situation where no definitive countermeasure to an invisible enemy can be found, the society may even fall into panic.

Additionally, due to the usage of various drugs in the treatment of infections, drug-resistant bacteria are beginning to appear one after another (antibiotics are also used in aquaculture and so forth). Even if a new drug is developed with effort to counter them, the bacteria adapt themselves quickly to obtain resistance. A new drug is developed again, for which the bacteria again acquire resistance; if this cycle is repeated until, eventually, we run out of new drugs, then mankind would return to the level of the first half of the 20th century in terms of infectious diseases.

The three major adult diseases are considered as curable by the advance in medicine in the future. At that point, again, we may need to engage ourselves in the fight with "epidemics."