

Vaccination knife

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Smallpox is a highly infectious disease that is spread by droplets via contact with an infected individual or by direct contact with infected bodily fluids or contaminated objects. The onset of smallpox is acute with a fever that can increase to or exceed 38.3°C followed by the appearance of a rash. The rash is characterised by firm, deep-seated vesicles or pustules at the same stage of development. Case fatality can be as high as 50%.

Smallpox is an ancient disease, first documented in medical writings from ancient India as early as 1500 BC. The disease was carried to China during the first century AD. By the mid-18th century, smallpox had spread worldwide and a major cause of death in affected countries.¹

The disease is caused by the variola virus, belonging to the family of orthopoxvirus. There are four orthopoxviruses: variola, vaccinia, cowpox, and monkeypox. Variola virus infects only humans, while the other three orthopoxviruses can infect both humans and animals.² Long before the discovery of the virus, it was recognised that a person who contracted one form of the virus became immune against all other forms, which is the basic principle of variolation and vaccination.

Variolation against smallpox was introduced in China in the late 10th century. Several methods of inoculation were used including blowing powdered smallpox scabs or placing a pledget of cotton impregnated with smallpox scabs into the nose of a child, or wearing the unwashed undergarment of a child with smallpox for 2 to 3 days. Nonetheless severe reactions sometimes occurred with variolation.³

In 1718, Lady Mary Wortley Montagu, who observed variolation during her stay in the Ottoman Empire, became an enthusiastic proponent on her return to England. As a result, variolation became widely practised in England, Europe, and the North America. In 1796, Edward Jenner, a doctor in Gloucestershire, England, first used the material from a cowpox lesion, which he called 'vaccine', for inoculation to produce immunity to smallpox in humans. Vaccination, which produced effective immunity but only caused a mild reaction, was much safer than variolation and soon replaced the latter.¹

Jennerian vaccination was introduced in China in 1805 via Macao and Guangzhou by Alexander Pearson, a surgeon to the East India Company.³ He wrote a pamphlet on the technique of vaccination, which was translated into Chinese, and he also trained several Chinese employees of the British

factory. One of his first trainees, Qiu Xi (邱熿), became wealthy as a vaccinator and passed on the technique to his children and grandchildren making it a family business.³

Qiu Xi published his own book in 1817. He described the method of Pearson using the language of acupuncture, naming the meridian points on the arm where incisions were to be made and explaining the pustules as "fetal toxin" being liberated. He even provided aftercare using traditional Chinese medicine.³ Qiu performed vaccination by making an incision and introducing a foreign substance into the body, thus breaking the rules of Chinese traditional medicinal practice. Despite this, vaccination became widely accepted in Southern China in the early 19th century as a result of his efforts and those of other early vaccinators.

Lymph supply throughout the year in those days was ensured by the "charitable vaccination dispensary", where poor children were vaccinated and the lymph extracted from the resultant lesions was directly applied on the child to be vaccinated. Because of the possibility of transmitting diseases such as leprosy by this arm-to-arm transmission method, vaccinators improvised ways to produce lymph including inoculation of young buffaloes through the nostrils with powdered human smallpox scabs.³

When Hong Kong became a British colony in 1842, traditional variolation was extensively performed.⁴ Although Benjamin Hobson, a missionary doctor, was the first to vaccinate Chinese children at the Medical Missionary Society Hospital on Morrison Hill,⁵ it was only after the founding of Tung Wah Hospital in 1872 that employed Chinese vaccinators that vaccination became accepted by the local community. Dr PBC Ayers, Colonial Surgeon (1873-1897), praised Tung Wah Hospital for its efforts in vaccination. Although he vaccinated the European community and patients under his care, he did not have a programme for the Chinese community because of the extensive vaccination work carried out by Tung Wah.⁶

Pearson practised the single linear cut/scratch method using a lancet as illustrated in the Figure. He made only one incision in one arm. Qiu modified his method by making two incisions on both arms along the meridian of acupuncture points. The vaccine was introduced onto the incisions using ivory points shaped like a lancet blade.³ To prevent secondary infection, rigid guards, shields, or cages were placed



FIG. Short vaccination knife, made in France in the 19th century, was acquired in 2009 by the Hong Kong Museum of Medical Sciences Society from the Pasteur Institute, Paris. It has a steel lancet (3.3 x 0.8 cm) with tortoise shell guards (6.2 x 0.8 cm)

over the vaccination sites to allow natural healing. It is likely that the vaccinators of Tung Wah Hospital used Qiu's method as they were trained in South China by Qiu's descendants or by trainees of the early vaccinators taught by Pearson.

Other more complicated instruments were designed such as a spear-pointed lancet with a groove for holding the vaccine, or spring-loaded lancet. These gave way to simpler, easily sterilised and/or dispensable instruments such as surgical needles or even darning needles used with special handles. The incision method was widely used as it was simple and rapid, and could be used for multiple site inoculation.⁴

Another method of vaccination was by puncture, a stabbing action at a right angle or acute angle to the site. A variety of mechanical, spring-loaded devices that could control the depth of penetration were developed but they were difficult to clean. In 1961, a bifurcated needle was introduced; it was simple and could be used by auxiliary workers after minimum training. This method saved 75% of the volume of the vaccine and was widely used in the Eradication Programme against Smallpox of the World Health Organization in the 1960s and 70s.⁷

The third was the multiple pressure method,

performed with the flat of an instrument such as the flat of a blade or a Hagedorn needle, that was flattened on the sides and firm pressure was applied to the skin of the upper forearm where a drop of vaccine was placed. The pressure tore the stratum corneum slightly and the inoculum was deposited in the epidermis.⁷

Hong Kong ran many major vaccination campaigns during the early 20th century in an attempt to reduce the severity and mortality from smallpox epidemics. The Vaccine Institute (1892-1906) and the Bacteriology Institute, built in 1906, produced smallpox vaccine lymph for use locally and in neighbouring areas such as Guangzhou. The massive vaccination campaigns involved not only Tung Wah Hospital but all other hospitals and Chinese public dispensaries.⁸ Vaccination campaigns continued after the Second World War. During the post-war years, the government hired inoculators trained in China to carry out smallpox vaccination and other immunisation in the field. According to Patricia Ko-Woo, Chief Nursing Officer at the Department of Health in the 1950s and 1960s, the most common method employed then was to produce two to three abrasions on the skin of the upper arm, or upper thigh and occasionally on the sole of the foot, using a small blade similar to a later version of one shown in the Figure. Only one site was inoculated at one time. Later on, needles were used to produce five to six pricks on the skin. In both methods, the drawing of blood was to be avoided. Revaccination was recommended every 2 to 3 years.

The last case of smallpox in Hong Kong was recorded in 1952 and Hong Kong was declared free of smallpox in 1979.⁹ In 1967, the World Health Organization set in motion a global Smallpox Eradication Programme using intensive vaccination, surveillance, contact tracing, and isolation/quarantine. The Programme succeeded and the last naturally occurring case of smallpox was reported on 26 October 1977. On 8 May 1980, the World Health Assembly announced that the world was free of smallpox and recommended that all countries cease vaccination.⁹

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