

The calf vaccinating table

Samson SY Wong, FRCPATH, FHKCPATH

Member, Education and Research Committee, Hong Kong Museum of Medical Sciences Society

This has to be the highlight of any visit to the Hong Kong Museum of Medical Sciences—mannequins of two men and a buffalo calf on a table, the calf vaccinating table (Figs 1 and 2c). The existing calf table was transferred to the Hong Kong Museum of Medical Sciences by the Department of Health in 1996. The table was manufactured locally and was in use from the mid-1940s to the 1970s. A description on the equipment that accompanied the transfer is as follows¹ (Fig 2a):

In the process of smallpox vaccine production, a buffalo calf was led to stand alongside the teak table top which has been hinged vertically. The calf was fastened manually on the table. The holes and grooves on the table top were devices to drain off the cleansing water. Once the animal was immobile [sic], the table top was hinged upwards with the calf lying on it horizontally. The calf's right leg was then fastened to the curved, iron retort stand so that its belly was completely exposed and ready for shaving, cleansing, disinfecting and eventually vaccinating by scarification.

The table is the most recognisable relic of a unique function of the old Bacteriological Institute, viz vaccine production. The Bacteriological Institute produced smallpox vaccine from the early 1900s until 1973.² Records indicate that when the Government Bacteriologist took over the role of Director of the Government Vaccine Institute in October 1902, 4616 tubes of smallpox vaccine had been produced from 23 calves in that year.³ The vaccines produced

were not only used locally (hospitals and private doctors), but also delivered to the naval and military authorities, as well as Canton and other neighbouring ports.³ The annual quantity of vaccines produced varied. For example, following a local epidemic of smallpox, 137 646 tubes of vaccine were issued in 1923.⁴ It is interesting to note that the initial uptake of smallpox vaccination in the local population was rather lukewarm, but it increased after 1928 as a result of greater community engagement by various non-governmental organisations.⁵

Smallpox was one of the deadliest infectious diseases of mankind until 1977. Hong Kong was free from the disease for 2 years before being declared smallpox-free in July 1979.⁶ Vaccination played a crucial role in global eradication of the disease. The story of cowpox vaccination by Edward Jenner in 1796 marked the earliest systematic use of human vaccination for the prevention of infectious diseases. The first-generation smallpox vaccines were originally produced by inoculating animals with infectious materials by scarification, followed by harvesting of the vesicle fluid (the so-called 'lymph') from the animals and subsequent storage of the vaccine as a freeze-dried product (Fig 2b). Calves were most commonly used for this purpose, although donkeys and horses could also be used.⁷ Buffalo calves were kept in the animal house of the Bacteriological Institute for this purpose. Similar tables were used in other countries in the past for vaccinating calves and harvesting of lymph.⁸

The form of smallpox encountered in Hong Kong was mostly variola major, the more severe form of the disease with an overall case-fatality ratio of around 30%.⁹ Although smallpox was a statutory notifiable disease even in the early days of colonial Hong Kong, it was estimated that as many as two thirds of cases were not notified because many local Chinese considered it a relatively minor condition that was managed by herbalists.⁵ Dr Uttley, a local medical officer, reported a crude death rate from smallpox of 0.46 per 1000 population (range, 0.01-2.27 per 1000) for the years 1897 to 1936.⁵ Mortality of smallpox among the local Chinese was highest among children, with 53% of fatal cases occurring in children under 3 years of age, and 72% occurring in children under 5. In contrast, in contemporary England and Wales, smallpox mortality was highest among adults aged 25 to 45 years. The discrepancy was believed to be due to better childhood smallpox



FIG 1. The calf vaccinating table in the Hong Kong Museum of Medical Sciences



FIG 2. (a) Staff of the old Pathological Institute vaccinating a buffalo calf. From Hong Kong Museum of Medical Sciences Archives, donated to the Hong Kong Museum of Medical Sciences Society by staff of the former Pathological Institute. (b) Finished product of the smallpox vaccine manufactured by the Bacteriological Institute. (c) Present-day demonstration of smallpox vaccine production on the calf vaccinating table



FIG 3. Local relics of the history of smallpox in Hong Kong

(a) Grave of a local smallpox victim in the 19th century located in the Hong Kong Cemetery. Inscriptions on the headstone of the grave read, "In memory of the late John L. Langan, torpedo instructor of HMS Undaunted, who died of smallpox at Hong Kong on 15th February 1899, aged 31 years." (b) Remains of the Tung Wah Smallpox Hospital, A.D. 1910, currently located in Sai Ning Street, Kennedy Town. Foundation stone laid by Sir Henry Arthur Blake, G.C.M.G., Governor of the Colony of Hong Kong, on 18 November 1901. Inscription on the top of the foundation stone reads, "The arch and the foundation stone were once part of the Tung Wah Smallpox Hospital, completed in 1910, not far from this spot. In 1938, the building became the Government Infectious Disease Hospital, and was demolished after the Second World War."

immunisation coverage in England and Wales with subsequent waning of immunity during adulthood.⁵ Although smallpox had been a scourge of mankind for centuries, few relics of the history of smallpox remain in Hong Kong. Today, a tomb of a young naval officer who died from smallpox in the late 19th century in Hong Kong can still be found (Fig 3a). Another indication of the public health significance of the disease in Hong Kong was the Tung Wah Smallpox Hospital, of which only the arch and foundation stone remain (Fig 3b). It was built originally to house plague patients in 1902 and converted to become one of the several early health care facilities dedicated to the care of smallpox patients. It was later changed to an infectious disease hospital prior to its demolition.⁶

Although smallpox has been eradicated for 40 years, lessons from the virus and the disease remain relevant to us today. Routine vaccination against smallpox is no longer necessary but vaccination is still implemented in certain special populations, such

as military personnel in some countries or laboratory workers who handle poxviruses.¹⁰⁻¹³ Research on smallpox and related vaccines remains active in the ever-present threat of bioterrorism and the need for protection against other poxvirus infections of humans, such as monkeypox. Newer second-, third-, and fourth-generation smallpox vaccines have been developed using cell cultures of live-attenuated viruses or recombinant subunits, although only very few of these newer-generation vaccines (eg ACAM200, Sanofi Pasteur) have been licensed for human use.^{14,15} The vaccinia virus and its derivatives, as well as other poxviruses, have also found new life in medicine as they may serve as vaccine vectors against a number of infectious diseases and even for treatment of cancers because of their oncolytic properties.^{14,16} Last but not the least, as the only human infectious disease that has ever been eradicated through human interventions, the story of smallpox remains an invaluable legacy in public health and other disease eradication programmes.¹⁷

References

1. Lau CH, Department of Health. Letter to the Hong Kong Museum of Medical Sciences on the transferral of old equipment. 9 January 1996. Data on file in the Hong Kong Museum of Medical Sciences.
2. The Bacteriological Institute and its contributions to Hong Kong. In: Hong Kong Museum of Medical Sciences Society. Plague, SARS and the Story of Medicine in Hong Kong. Hong Kong: Hong Kong University Press; 2006: 147-224.
3. Hunter W. Report of the Government Bacteriologist, for the year 1902. Hong Kong: Government Public Mortuary; 1903.
4. Minett EP. Report of the Bacteriological Institute, 1923. Hong Kong Government; 1924.
5. Uttley KH. The death rate and epidemiology of smallpox in Hongkong. *Trans R Soc Trop Med Hyg* 1938;31:635-46.
6. History of infectious disease in Hong Kong: a story of discovery and challenge. In: Hong Kong Museum of Medical Sciences Society. Plague, SARS and the Story of Medicine in Hong Kong. Hong Kong: Hong Kong University Press; 2006: 17-74.
7. Parrino J, Graham BS. Smallpox vaccines: Past, present, and future. *J Allergy Clin Immunol* 2006;118:1320-6.
8. Lymph from calf 2. The Historical Medical Library of The College of Physicians of Philadelphia. Available from: <http://www.historyofvaccines.org/content/lymph-calf-2>. Accessed 21 Nov 2016.
9. Moore ZS, Seward JF, Lane JM. Smallpox. *Lancet* 2006;367:425-35.
10. Artenstein AW. Vaccines for military use. *Vaccine* 2009;27 Suppl 4:D16-22.
11. Department of Health, United Kingdom. Guidelines for smallpox response and management in the post-eradication era, Version 2. Available from: http://webarchive.nationalarchives.gov.uk/20110907164128/http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/documents/digitalasset/dh_4070832.pdf. Accessed 21 Nov 2016.
12. Public Health England. Smallpox and vaccinia: the Green Book, chapter 29. 2013. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/148501/Green-Book-Chapter-29-dh_063660.pdf. Accessed 21 Nov 2016.
13. Petersen BW, Harms TJ, Reynolds MG, Harrison LH. Use of vaccinia virus smallpox vaccine in laboratory and health care personnel at risk for occupational exposure to orthopoxviruses – Recommendations of the Advisory Committee on Immunization Practices (ACIP), 2015. *MMWR Morb Mortal Wkly Rep* 2016;65:257-62.
14. Verardi PH, Titong A, Hagen CJ. A vaccinia virus renaissance: new vaccine and immunotherapeutic uses after smallpox eradication. *Hum Vaccin Immunother* 2012;8:961-70.
15. Nalca A, Zumbun EE. ACAM2000: the new smallpox vaccine for United States Strategic National Stockpile. *Drug Des Devel Ther* 2010;4:71-9.
16. Kim M. Replicating poxviruses for human cancer therapy. *J Microbiol* 2015;53:209-18.
17. Tomori O. From smallpox eradication to the future of global health: innovations, application and lessons for future eradication and control initiatives. *Vaccine* 2011;29 Suppl 4:D145-8.