SMALLPOX IN BRADFORD, 1962

BY

JOHN DOUGLAS, M.D., D.P.H.
Medical Officer of Health, Bradford

AND

WILLIAM EDGAR, M.B., Ch.B., D.P.H., D.C.H.
Deputy Medical Officer of Health, Bradford

The outbreak of smallpox in Bradford came to light on Thursday, January 11, 1962, after the death of a patient (Case 1) in D 2 ward at St. Luke's Hospital. This patient had been admitted the previous day with a provisional diagnosis of thrombocytopenic purpura. His colour on admission was described as similar to that of a cockscomb, so vivid were his face and extremities. There was no focal rash and he died within 24 hours of admission. Death was thought to be due to haemorrhagic smallpox.

This diagnosis was possible because a woman (Case 2) who had been under observation in Leeds Road Fever Hospital from January 10 as a probable case of haemorrhagic smallpox, and who was employed as a cook at the Bradford Children's Hospital, had presented an identical clinical picture to Case 1. It then became obvious that five children (Cases 3, 4, 5, 6, and 7) in A 1 ward at the Bradford Children's Hospital (one of whom, Case 7, had been transferred to Wharfedale Children's Hospital) who had been under observation with spots from January 9–10 were also likely to be cases of smallpox.

A decision was taken on January 11, in consultation with the officers of the Leeds Regional Hospital Board, to quarantine the four hospitals concerned—viz., Bradford Children's Hospital, St. Luke's Hospital, Leeds Road Fever Hospital, and Wharfedale Children's Hospital—and to vaccinate and place under surveillance all the staff and patients in the hospitals and to remove the suspected cases to Oakwell Isolation Hospital, Birstall.

Source of Outbreak

On the following day, January 12, it became apparent that the source of the outbreak was almost certainly a 9-year-old Pakistani girl who arrived in this country by air from Karachi on December 16. She became ill and was admitted to the Bradford Children's Hospital on December 23 with malaria. This diagnosis was confirmed by a blood film which showed numerous *Plasmodium vivax* parasites, mostly in the ring stage. Antimalarial treatment reduced the temperature to normal and she remained afebrile until December 29, when her temperature rose again and she died the next day with nothing to suggest that the death was due to smallpox. Death was attributed to staphylococcal septicaemia, and *Staphylococcus albus* was recovered later from blood culture.

Because of the apparently long incubation period, a careful inquiry was necessary to eliminate a possible source of infection in this country. During the course of these inquiries it was found that a post-mortem examination had been performed at the Bradford Royal Infirmary, and thus a fifth hospital became involved in the outbreak. All staff of the hospital were vaccinated and the staff of the pathology department were placed under medical surveillance. In the case of the pathologist (Case 8) who performed the post-mortem

examination, this was a primary vaccination performed on the eleventh day after known contact, too late to prevent the onset of the illness. He was taken ill on the evening of January 12 and was removed to Oakwell Hospital the following day.

A nurse at Bradford Children's Hospital (Case 9) who had been removed for observation to Leeds Road Fever Hospital on January 11 was also regarded as a case of smallpox and transferred to Oakwell Hospital. On January 14 a child (Case 10) who had been in A 1 ward at the Bradford Children's Hospital in cot 18 adjacent to Cases 3 to 7 at the same time as the Pakistani girl, and who had been discharged home on January 3 and was under medical surveillance at home, was found to be pyrexial and to have a macular rash suspicious of smallpox, and was removed to Oakwell Hospital. This completes a total of 10 secondary cases (one occurring outside the city) from the original presumed source of infection—the Pakistani girl.

Plan of A 1 ward, Bradford Children's Hospital.

A plan of A 1 ward (see Diagram), showing the bed occupancy during the period when the original child was known to be infectious, shows that all the secondary cases occurring in children in the ward were in the cots marked 16–21, adjacent to each other and to the original child in bed 15.

The recognition of 10 cases of smallpox within a period of 72 hours presented a grave picture, particularly as it was appreciated that spread of infection had already occurred in the following ways:

(a) Cases 3 to 6 had been exposed in A 1 ward in the infectious stage of smallpox from January 7 to 10, and the risk of infection to the other children in the ward, to the medical and nursing staff, relatives, and visitors was extremely high. Because of the movements of the nursing staff, infection had probably been conveyed to the other wards and departments. Many children had already been discharged home, and there was therefore a risk of dissemination both within and outside the hospital.

(b) Case 1 had attended work in the public abattoir on January 6 and 7 when he was known to be ill and presumably infectious. His job meant contact with numerous people in the abattoir.

(c) Case 8 attended a magistrates' court in the Town Hall on the morning of January 13, using public transport to and from the court. In addition he called into a central post office and into one of the largest stores in the city before returning to the hospital.

Fortunately, the movements in the community of Cases 2 and 9 were much less, as they were resident members of the hospital staff.

Surveillance of Contacts

The task of tracing, vaccinating, and placing under surveillance, with as little delay as possible, all the contacts was enormous, and it was agreed that a designated member of the medical staff at each hospital would be responsible to the M.O.H. for the medical surveillance of all hospital staff and patients. In this way a considerable burden was taken from the medical staff of the Health Department.

The fact that many of these contacts had been exposed to the risk of infection as long as six days previously, with a consequent delay in vaccination, added greatly to the urgency of the task, and one could confidently foresee at this stage at least 20–30 cases of smallpox occurring in the following weeks among people known to have been close contacts of the now confirmed cases at a time when these cases must have been infectious and they themselves unvaccinated. It is estimated that nearly 900 contacts were under surveillance in the city by the medical staff of the Health Department and hospitals during the outbreak.

Because of the large number of people involved—that is, patients, medical, nursing, and ancillary staffs, visitors, and contacts of the cases themselves during the infectious stage of their illness—it was felt that the opportunities for the spread of infection in the city were considerable. While all known cases could be accounted for, what was uncertain was how many other people had been infected who were free to move about the city. Accordingly, while mass vaccination was at no stage recommended, there was ample justification for catering for the public demand for vaccination, particularly among the large numbers who had had some recent contact with the hospitals and cases concerned. It is estimated that between Saturday, January 13, and Wednesday, January 17, approximately 250,000 people were vaccinated in this city. This particular task was accomplished principally by medical and nursing staff from neighbouring authorities and by medical practitioners in the city.

Since Bradford hospitals serve a larger area than the city of Bradford itself, it was inevitable that some patients, visitors, and staff of the hospitals resided outside the city, and from the outset, therefore, the outbreak involved the adjacent areas of the West Riding.

On January 13 all the available information concerning the outbreak, including a table showing the dates of onset of illness and appearance of rash of each known case, was sent to all medical practitioners in the area and to adjacent medical officers of health. A meeting was held on January 18, to which all surrounding medical officers of health were invited, to explain to them the nature of the outbreak and to inform them of the system which had been adopted with regard to the surveillance of contacts and the special arrangements for the surveillance of hospital staff. This was greatly appreciated by them, and cleared many anxieties relating to "contacts" in their areas.

Spread of Infection

The mode of spread has not been established. The original case was an ill child who was unable to move out of her bed and none of the children in the cots were ambulant and able to contract infection by direct contact with the original case. Aerial spread is discounted as a result of subsequent smoke tests undertaken in the ward. No system of ward round practised by the medical or nursing staff would account for the occurrences. The children in the cots were either infants or children requiring considerably more nursing attention and care than children in the other beds in the ward. Infection may therefore have been carried by a member of the medical or nursing staff without her actually developing the disease, although Case 9 was on duty in the ward during the period December 28 to 30.

It has not proved possible to establish how Cases 1 and 2 were infected, since both died before the significance of their earlier movements could be appreciated and accurately ascertained. While the cook was not in the habit of visiting the wards, it is known from relatives that she attended a New Year's party in the ward, and it seems possible, therefore, that she may also have had some contact with the ward during the Christmas festive period, and thus had contact with the Pakistani child.

Case 1 attended the Bradford Children's Hospital with his wife on December 28, when his child was admitted to A 1 balcony. This does not necessitate entering the main ward itself, and his wife confirms that he did not do so on this occasion. As this was his only visit to the hospital prior to the death of the Pakistani child, he must presumably have been infected on this occasion.

The incubation period to the onset of symptoms in Case 1 and probably Case 2 also was therefore only nine days. Neither of these cases had a focal eruption; one died six days after onset of symptoms, the other seven days after. The incubation period for the remaining secondary cases, assuming infection took place on December 28 or 29, was 9 to 14 days. In the case of the pathologist the date of infection can be fixed as January 1, the date of the post-mortem examination. This gives an incubation period of 11 days. As none of the patients were vaccinated until the eleventh or twelfth day it can be assumed that vaccination had no material effect upon the incubation periods.

Cases 3 to 11 were admitted to Oakwell Hospital, and the consultant in charge was of the opinion that none showed any evidence of previous successful vaccination prior to the outbreak. Similarly, no satisfactory evidence is available that Cases 1 and 2 had had previous vaccination, although it seems probable that Case 1 had been vaccinated when he was stationed in the Middle East during the war.

This is in contrast to the vaccinal history of the Pakistani girl, who was vaccinated in infancy and re-vaccinated along with her mother and father on December 5, 1961. International vaccination certificates were inspected for all three (after the child's death) and the parents were examined by a member of the smallpox panel, who found on each parent scars of successful primary vaccination and recent similar scars consistent with successful revaccination. It would appear unreasonable to suggest that the certificate of the child,

completed at the same time, was not valid. The father stated that the child's arm was red for a few days after revaccination, but that no crust or scar developed. It is more probable, therefore, that revaccination was not successful.

Of the two "third-generation" cases which occurred in D2 ward, both were successfully vaccinated within 24 hours of exposure, and, although this did not prevent their contracting the disease, it was in each case in a very mild form. It is possible that their advanced ages (63 and 77) and the associated serious medical conditions for which they were originally admitted to the hospital were responsible for some delay in the normal response to successful vaccination.

A further "third-generation" case occurred outside the city in a child in the same ward as Case 7 at Wharfedale Children's Hospital.

The death rate during this outbreak was particularly high. Out of a total of 12 cases of smallpox occurring in Bradford and a further two in Wharfedale Children's Hospital, six died from the disease and one from other causes.

Conclusion

This preliminary report is intended to record in the briefest possible manner the occurrences of the past month, and to express appreciation to all those who helped to achieve what at one time appeared impossible.

Almost exactly one month after coming to light it was possible to announce that the outbreak was over. This achievement speaks well of the diligence of the medical officers and staff of the department and the hospitals and adjacent authorities who undertook with such success the painstaking task of tracing and vaccinating such a large number of contacts, and who subsequently kept these contacts under surveillance until the risk of infection had passed.

Many interesting aspects of the outbreak—for example, the apparent absence of third-generation cases in the community; the relative absence of serious complications to vaccination in the city; the effects of vaccination upon expectant mothers and on patients receiving steroids—will be dealt with in the final report.

We wish to express our indebtedness and appreciation to the Ministry of Health; to officers of the Leeds Regional Hospital Board; to medical, nursing, and administrative staff of the hospitals concerned; and particularly to the surrounding medical officers of health for their forbearance and to the members of the staff who assisted with the public vaccination sessions.

From May 5 trained first-aiders who are required to be in charge of first-aid boxes or cupboards at docks, wharves, or quays where more than 50 persons are employed will have to be registered or enrolled nurses, or the holders of valid certificates in first-aid issued by a training organization. These regulations bring the requirements at docks, wharves, or quays into line with those already specified for factories in the First-Aid (Standard of Training) Order, 1960. Training organizations for this purpose are defined as the St. John Ambulance Association of the Order of St. John, St. Andrew's Ambulance Association, the British Red Cross Society, or any other body or society approved by the Chief Inspector of Factories. (The Docks (Training in First-Aid) Regulations, S.I. 1962, No. 241; H.M.S.O., price 3d. net.)

Medical Memoranda

Smallpox Vaccination in a University and Economy in Use of Vaccine

The recent outbreak of smallpox in this country coincided with the beginning of the spring term. Students were arriving from all parts of this country, Europe, and the Middle East. It was decided as a precautionary measure to offer vaccination to all who wanted it. The demand for vaccination was for a time greater than the Public Health Authority's ability to supply vaccine. Maximum economy was observed in using the lymph available. This report deals with the results of the first 1,809 adult vaccinations.

Method.—About 30 subjects were vaccinated from each individual dose capillary of lymph. A small quantity was tapped out of the capillary tube on to the surface of a microscope slide which had been previously sterilized by flaming. A Hagedorn needle, dipped into lymph on the slide, was used to introduce the vaccine through a single scratch approximately $\frac{1}{4}$ in. (6 mm.) long made on the upper arm. The site of vaccination was left uncovered. Primary vaccinations were inspected on day 7. Revaccinations were inspected on days 2 and 4.

Results.—Of 1,809 persons vaccinated, 603 (33%) were being vaccinated for the first time. The Table summarizes the results.

Numbers of Patients Vaccinated and Results of the Vaccinations

	No. Vacc.	A	B	C	D	E	F	G
Primary vaccination	603	585	—	—	18	3	1	14
Revaccination	1,206	—	366	744	96	41	13	41
Totals	1,809	1,695			114	44	14	55

A=Typical primary vaccinia (maximum 7–10 days). B=Accelerated reaction (maximum 5–7 days). C=Local reaction without vesiculation. D=No local reaction. E=Positive reaction at second attempt. F=No local reaction at second attempt. G=Patients either refused second attempt or referred to own G.P.

The proportion failing to "take" at the first attempt was 3% in the case of primary vaccinations and 8% in the case of revaccinations. Of the successful revaccinations 366 (33%) showed an accelerated reaction with vesiculation, while 744 (67%) exhibited only a local papular reaction. A certain number of those whose revaccinations did not take either refused further revaccination or were referred to their general practitioner. Of the 54 patients who attended for a second attempt, 41 (76%) were successfully vaccinated at that time. Including these, the overall successful vaccination rate was 96%.

COMMENT

It would appear from the present series that in times of emergency it is possible to vaccinate successfully using only 1/30 of the usual quantity of vaccine per person.

There is a belief even in the profession that the absence of local reaction in a person being revaccinated is an indication of immunity, and that a further attempt at revaccination is not necessary. We have found that 76% of "failed" revaccinations "take" at the second attempt and 20% of these show vesiculation.