REFRESHER COURSE FOR GENERAL PRACTITIONERS

THE DIAGNOSIS OF SMALLPOX.—II

BY

THOMAS ANDERSON, M.D., F.R.C.P.Ed., F.R.F.P.S.

*Reader in Infectious Diseases, University of Glasgow, at the Brownlee Laboratory, Ruchill Hospital, Glasgow***Variations in the Rash**

Two factors influence the character of the rash in smallpox—the resistance of the individual and the virulence of the virus.

Resistance of the Individual.—Here, previous vaccination is the most important factor. With the passage of time immunity wanes, and should the disease be contracted its whole course may be “modified.” It is not untrue to say that to those unacquainted with the disease this term implies a simple alteration in the number of lesions—the more modified, the sparser the rash. Such a concept is only a part truth and from a diagnostic point of view may be dangerous. Previous vaccination can alter not only the number but the whole character of the lesions; only one factor may remain constant—the capacity to infect susceptible persons with the most severe form of the infection. In particular, stress might be placed on the following points:

(1) Although generally the number of lesions is greatly reduced, an almost confluent form may be encountered in previously vaccinated persons. The element of the eruption, however, is much smaller, and, despite the profuseness of the eruption, the secondary toxæmia is never profound and scarring is greatly reduced. Many of the lesions fail to become vesicular.

(2) In the more resistant subject, the individual lesions are less deeply situated in the skin. As a result the progress from stage to stage is more rapid. In such a case the metamorphosis from papule to pustule may take place in twenty-four to forty-eight hours.

(3) Some of these softer, more superficial lesions may progress from papule to scab so rapidly that lesions are present at different stages and a superficial appearance of cropping is presented. Such an appearance is enhanced by the abortion of some of the lesions at the papular stage. It is possible, in fact, that a certain amount of cropping may occur in such cases, successive papules occurring over a period of three to four days, so increasing the resemblance to chicken-pox. (In this connexion it is worth while pointing out that on rare occasions the chicken-pox virus may be attracted to traumatized skin. This has been seen, for example, in a theatre nurse whose arms and hands were affected by scrubbing and disinfectant irritation; or in a child around the buttocks or lower abdomen, where the skin was excoriated by neglect.)

Virulence of the Virus.—The virus of variola major has preserved throughout its history an almost uniform virulence, so that variations in the severity of the disease which it produces are almost entirely explained by variations in the resistance of the host. The virus of variola minor, on the other hand, is one which has been shorn of much of its attacking power. As a result, it produces a mild form of smallpox (alastrim) irrespective of the state of resistance of the host; and, moreover, this mildness “breeds true,” so that susceptible contacts are also affected by a more or less non-fatal illness. But it is still smallpox: and a modified attack of variola major due to enhanced host-resistance may be indistinguishable from an attack of variola minor due to a virus of reduced virulence. This point is worth emphasizing, for it means that the important features of the disease which have been described above are true for both forms.

As with the modified disease, we may expect to observe in alastrim differences in the individual elements and their evolution. In the first place they are usually smaller and more superficial, so that their shape is much less uniform. Their evolution is much more rapid and the pustular stage may be reached on the third or fourth day. The vesicular stage is of very short duration, and indeed may escape detection. But, no matter what alterations there may be in the character of the eruption, the rash still shows the pattern of smallpox. It is a symmetrical rash, affecting the face and limbs more than the trunk, the extensor aspects rather than the flexor, the prominences rather than the sheltered areas.

Vaccination

Recent successful vaccination is an absolute protection against smallpox. This might well be treated as a text for an old-fashioned sermon which would then develop the theme under three heads—recent, successful, and vaccination.

Duration of Vaccinal Immunity.—No form of artificially acquired immunity is lifelong. It should therefore occasion no surprise that, with the passage of time, the immunity conferred by vaccination wanes. It seems probable that the duration of immunity is related to the extent of the primary stimulus, and that this in turn may be related to the amount of skin involved in the vaccinal reaction. In recent years the tendency has certainly been towards a reduction in the amount of skin trauma involved in the operation. It may be that this minimal form of vaccination reduces the duration of complete protection. Whether this is true or not, it is certainly the case that there is great individual variation in the length of the immune period. As a broad generalization, it may be accepted that successful vaccination gives a guarantee of immunity for one year and probably for three years. Some degree of resistance may remain for from 10 to 20 years or even longer. Workers who may be exposed to the disease should be vaccinated annually. But “recent” must also include reference to exposure. Ricketts taught that successful vaccination within the first seven days of exposure would often prevent an attack, and many people remember this dictum loosely and believe that it states an absolute truth. But Ricketts, right in this as in so many other areas of our knowledge of smallpox, stated that what really mattered was not when the patient was vaccinated but when the vaccination “took.” For complete protection successful vaccination must be attained before exposure takes place. While immediate vaccination of contacts must constitute an important aspect of smallpox control, too high a measure of protection must not be expected.

Successful Vaccination.—When an individual is vaccinated for the first time the success of the measure is easily established. After a degree of local irritation and itching the inflammatory reaction in the skin increases and between the fifth and seventh days a typical vesicle appears, which then proceeds to pustulation and scabbing. The reaction is accompanied by inflammation of the area, enlargement of the associated lymph nodes, as well as some degree of constitutional disturbance which is usually greater in the adult. When revaccination is carried out the degree of reaction will depend upon the amount of immunity remaining from the previous operation. After a long period of years there may be nothing to distinguish the result from a primary response; performed on a person more recently

vaccinated, the lesion may pass through its stages more rapidly, so that vesication appears on the third or fourth day (accelerated reaction). In some persons there may be no reaction.

In such a situation it is of course dangerously simple to regard an absence of response as indicating remaining immunity from previous vaccination. But a moment's consideration shows that this is indeed fallacious. In the first place, the lymph may have been carelessly stored or may have been faulty in some other way and incapable of producing a successful "take." In the second place (perhaps the commonest reason), the operation may have been imperfectly conducted. And finally—although this point is not fully proved—one gets the impression that an area of skin may, from frequent revaccination, become unreactive. If the person who is revaccinated is likely to come in contact with smallpox, absence of "take" must be regarded with suspicion. The operation should be repeated, with fresh lymph, on a new site and the reaction observed every 24 hours. Itching or irritation is usual, and a papule, often with minute vesication, forms within 24 to 48 hours. The unfortunate term "reaction of immunity" should not be used, because of the difficulty which arises in its interpretation. In some cases there is no doubt that it can be simulated by a reaction due to sensitization to the calf lymph.

Vaccination Technique.—The multiple pressure method of vaccination should be adopted. It is simplest to perform, is almost painless, causes least trauma to the skin, and is relatively free from severe local reaction. The skin site should be prepared by cleansing with acetone or ether, and care should be taken to see that the skin is dry before applying the drop of lymph. A number of pressures are made rapidly with a sharp Hagedorn or cutting needle held parallel to the skin surface. For primary vaccination 15 to 20 pressures are adequate; for revaccination 25 to 30 pressures should be made. The excess lymph can be wiped off with a piece of clean wool. No dressing is required. In the case of primary vaccinations the site should be inspected after one week; in revaccinations the patient should be asked to report on the second or third day. Comment may be made on one point of technique. There seems no doubt that some people still eject the lymph from the capillary tube by blowing through it with the mouth. This is a most reprehensible practice. A rubber teat should always be used. So far as is humanly possible vaccination should be conducted as an aseptic operation.

Laboratory Diagnosis

Although, almost as a *tour de force*, the virologist may demonstrate the presence of virus in the blood or throat during the prodromal toxic illness, from a practical point of view it is at the stage of eruption that his help will usually be sought. His tests will concentrate on two points: isolation of the virus, or demonstration of its presence by a serological test. One or other of the tests can be applied at any stage of the rash.

Microscopical Examination for Elementary Bodies.—Absolutely clean dry glass slides are required. With the blade of a scalpel the lesion is scraped sufficiently to produce a little "juice"—not blood. This is transferred to the glass slide and a thin smear made with it. Material from several lesions is taken and a number of similar smears are made. Six may conveniently be arranged along the length of the ordinary microscopical slide. If possible, several slides should be sent; up to a point, the more material supplied, the more chance is there of an accurate result. *The slides must not be heated.* After suitable staining the smears are examined under the oil-immersion lens of a microscope. In a well-taken preparation the elementary bodies are easily seen in considerable numbers. There is no doubt that the success of this examination is directly dependent on the care with which the slides are prepared. Attention to detail is therefore essential: the slides must be ren-

dered completely clean, vigorous scraping of the lesions must be avoided, blood must not be drawn, and purulent lesions must be avoided. This method is therefore best suited to the early stages of the eruption; once pustulation has formed, the presence of cell debris, micro-organisms, and pus cells may make interpretation very difficult. Further, while a positive result—which will be available within a few hours of the receipt of the specimen—is of great value, a negative result cannot be regarded as excluding the diagnosis of smallpox.

Isolation of the Virus.—This can be attempted at any stage of the eruption. Material may be submitted on glass slides, as already described, in capillary pipettes from vesicular or pustular lesions, or in screw-capped containers in the form of scabs. The chorio-allantoic membrane of the developing hen's egg is inoculated with the specimen after appropriate treatment. Two to three days later examination of the membrane visually will often be sufficient to make a diagnosis, although in doubtful cases further procedures may be necessary. This method is precise and highly accurate. Its only disadvantage is the time which it takes.

Complement-fixation Tests.—The presence of virus antigen may be shown in vesicular or pustular fluids or crusts by complement fixation. For this test fluid from vesicles is preferable, but thick smears on glass slides will also suffice. This is a rapid test which can be conducted in less than 24 hours, and has a high degree of accuracy.

These tests have added greatly to the precision of smallpox diagnosis. Like all biological tests they have their limitations, and no virologist would rely absolutely on any single test. With a reasonable amount of well-taken material all three may be performed as a routine. The actual demonstration of the virus growing in the chorio-allantoic membrane naturally gives the most conclusive proof of the diagnosis and is really essential for the differentiation of variola and vaccinia.

Summing-up

The diagnosis of the florid case of smallpox is comparatively easy. If the individual has some residual immunity from previous vaccination (modified smallpox) or is infected by a virus of reduced virulence (variola minor) the character of the eruption may be so altered as to make a correct diagnosis very difficult. In such cases the greatest reliance must be placed on the distribution of the rash—general and focal. The pattern of the rash is constant; when in doubt make an actual diagram and count the lesions in the different regions. Too much attention must not be paid to the traditional diagnostic points such as shottiness, size, shape, presence of umbilication, appearance of cropping, and lesions in the mouth or on the palms or soles. The doubtful case will be the modified case, and any or all of these points may prove unreliable. For this reason no mention has been made of the presence of vaccination scars; in the cases in which doubt arises scars are usually present and their presence may prove illusory.

The question to be answered by the clinician when confronted by a doubtful case, as Wanklyn has pointed out, is, Can this be smallpox? If the answer, reached after consideration of all the evidence gleaned from a careful examination of the whole patient, is "Yes," then the case must be regarded as one of smallpox and all necessary steps taken as required by the local medical officer of health. For, despite the emphasis placed upon the valuable aid which can be given by the laboratory, the final decision must be a clinical one. The analogy of diphtheria—preached by every fevers clinician for the past half-century—is apposite: when in doubt you submit a swab, give serum. So to-day in smallpox the decision to set in motion the administrative machinery of the public health service must rest with the clinician. When in doubt you submit specimens for virus examination, administer the case as one of smallpox, and inform the medical officer of health; that is the golden rule. The subsequent confirmation or

refutation of the diagnosis must nowadays lie with the laboratory. But this does not absolve the clinician from his primary responsibility. To miss the first case of smallpox in an outbreak may be a costly business—not alone in lives.

Next Refresher Course Article.—"Abdominal Hernia in Childhood," by Mr. Denis Browne.

Refresher Course Book.—The first 55 articles of this series (fully revised) are available as a book, price 25s. including postage, from the Publishing Manager, B.M.A. House, Tavistock Square, London, W.C.1.

A MODEL REHABILITATION AND TRAINING CENTRE

BY

HAROLD BALME, O.B.E., M.D., F.R.C.S.

Consultant Adviser on Rehabilitation to the United Nations and World Health Organization

On May 24, 1952, the President of the Austrian Republic, in the presence of a large number of Government officials and other leaders, performed the opening ceremony of what is probably the finest rehabilitation and training centre to be found anywhere in Europe. It is situated at Tobelbad, in delightful wooded country about nine miles from Graz, and has been built on the site of a former spa. The original property included a famous hunting lodge and hot springs, both owned by the Government, the former containing a very fine ceiling painting—the work of an Austrian painter of the early nineteenth century—which has to be preserved as a national trust.

Extensive new buildings have been erected over the site of the hot springs, affording ample accommodation for 250 patients as well as the staff of the centre. The river has been deflected from its former course and banked with stone, so as to pass through the grounds and provide a constant water supply.

These buildings have been put up and are owned by the Allgemeinen Unfallversicherungsanstalt (the United Accident Insurance Corporation), and it is an interesting fact that their decision to establish this splendid centre, and to offer first-class opportunity for the rehabilitation of accident cases occurring anywhere in Austria, was largely influenced by the arguments submitted to them by two young orthopaedic surgeons who were members of the first Rehabilitation Course held in this country under the auspices of the British Council. These Austrian surgeons were so impressed by the economic value of modern methods of rehabilitation and vocational training that on their return to their own country

they succeeded in persuading the United Accident Insurance Corporation to buy the Tobelbad property and erect a rehabilitation centre on the British model. Since that time the medical director of the centre, Dr. Georg Neubauer, has also attended a course on rehabilitation in Great Britain during a period of two months, and it is a great compliment to this country that the organizing, staffing, and equipping of this splendid centre have closely followed the British pattern.

Rehabilitation Centre

This is a large modern four-story building, with an attractive curved front and wide balconies, each provided with fitted window-boxes filled with geraniums, petunias, and other flowering plants. The wards are small—usually for three or four patients—and are light and attractive, with good beds, lockers, and other amenities, and each opening out on to the balcony.

In addition to a large dining-room for ambulatory patients, modern kitchens, and excellent administrative and medical offices, the centre contains the following special departments:

- (a) Plaster- and dressing-rooms, for applying or changing plasters and dressings.
- (b) A small operating-theatre. (All cases requiring major operation are transferred to Graz Accident Hospital.)
- (c) A well-equipped x-ray department.
- (d) A clinical laboratory.
- (e) Physical medicine department, with large and excellently equipped rooms for massage, electrotherapy, actinotherapy, electromyography, and light treatment.
- (f) Two remedial gymnasia, the smaller one being furnished with wall bars, rings, and other apparatus for individual treatment and exercise; the larger one being equipped for group exercises. Both have wooden floors, special mats for floor exercises, walking-handrails, mirrors, suspension beam, and wall bars.
- (g) Extensive and excellently equipped hydrotherapy department, including: (i) A large warm swimming-pool, fitted up for exercises and games; (ii) a small warmed bath, on the principle of the Hubbard tank, for individual exercises; (iii) a series of four long ankle-deep "walking-baths," one containing hot water, one cold water, one soft mud, and the other moist sand; (iv) individual baths and showers.
- (h) A small occupational therapy department.
- (i) An indoor play-room, with table tennis and other games.
- (j) Outdoor sports grounds, with facilities and apparatus for archery, football, volley-ball, basket-ball, outdoor gymnastic exercises, and with paths provided with obstacles, both on the flat and through a wooded hill, to train patients in walking over rough and uneven ground after injuries to ankles and feet.
- (k) A small prosthetic workshop, for the manufacture of temporary and permanent prostheses and other mechanical aids.

Vocational Training Centre and Accessory Buildings

This separate building is connected with the rehabilitation centre by wide covered-in passages, well decorated and with parquet floors, and containing a series of light, well-equipped class-rooms and workshops. These rooms, when completed, will be used for short courses of training in carpentry, metal work, wood-carving, leather work, shoe-making, tailoring, dressmaking, etc. It is not intended to use them for long or complete vocational training courses, such as are available in Government training centres, but rather as a means of giving both work therapy and vocational guidance to those undergoing physical and industrial rehabilitation before returning to their former employment or undertaking new courses of training. This vocational training centre may thus be regarded as an attempt to combine the main features of the Luton rehabilitation departments and an industrial rehabilitation unit.

The Rehabilitation Centre