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# SOME NOTES ON POLIOMYELITIS AND ITS CONTROL

by

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Over a large part of the world where vaccination has not been applied, the incidence of poliomyelitis appears to be increasing. However, detection of trends in a disease such as poliomyelitis is a matter of considerable difficulty for a number of reasons. Its incidence is low compared to many other communicable diseases and it is also very irregular from year to year. While the paralytic disease in its fully developed form is readily detectable if the health services are adequately developed, minor cases of paralysis are much more difficult to detect and, although this is less important, the non-paralytic form of the disease is extremely difficult to diagnose on clinical grounds since it is a relatively mild illness for which medical care may often not be sought and furthermore the clinical syndrome of aseptic meningitis may be caused by a number of other viruses and bacteria.

The problem facing the health officer in assessing the importance of paralytic poliomyelitis (which is in practice the only form with which he need seriously concern himself) is thus a very difficult one, the more so in countries with relatively underdeveloped health services and where other diseases of infancy and early childhood are prevalent. Statistical data on which he can rely is lacking or incomplete, and specific diagnosis by the attending physicians is complicated by the frequency with which there is a multiple pathology in illness in such areas. The handicapped poliomyelitic child may more often succumb to intercurrent infections.

The need for a reliable assessment is now paramount since we have a method whereby paralytic poliomyelitis can to a large extent be prevented. However, the Salk type vaccine is expensive and it cannot as yet be assumed that an eventual live vaccine will be cheap because of the extensive and expensive precautions needed during the manufacture. Both vaccines, but particularly the former, need a well-organized service to ensure proper application, including the administration of reinforcing doses without which satisfactory results cannot be hoped for.

The cost of prevention of paralytic poliomyelitis must be weighed against the results which can be expected and against the many other demands on the limited health budget.

The questions which need to be answered are:-

1. What is the extent of the burden of paralysis due to poliomyelitis on the community? How can this best be determined? What is its cost in terms of continuing patient care and loss of manpower? (Its cost in human suffering can hardly be estimated in material terms).

2. What measures can realistically be applied in the present stage of development and how and to whom should they be applied? What would be their cost, and how does this compare with cost of the existing burden on the population?

3. How can the cost of these measures be met? What other services might have to be reduced and what would be the probable consequences of such changes?

In addition to this strictly material approach consideration will also have to be given to the emotional or psychological reaction of the population to the disease. In some countries this is out of all proportion to the material consequences.

Obviously many of these questions can only be answered in the light of local conditions. These notes are directed principally to the ways in which answers to the first questions can be obtained, taking into

account not only the actual situation at the present time but the changes which may be anticipated in the future by analogy with the trends already observed elsewhere.

Estimation of the burden of paralysis on the community.

Assuming the absence of reliable country-wide statistics this can be done by various sample survey methods looking for evidence of paralysis, especially in children. These should be preferably carried out under the guidance of a statistician experienced in such methods, since if the findings are to be used for extrapolation to other areas, or the country as a whole, some form of random sampling is necessary. Guidance on sampling methods will be found in the report of the WHO Study Group on Immunological and Haematological Surveys (WHO/Imm.Surv./4), the principles being the same whatever the finding to be looked for. In this instance the finding is evidence of lower motor neurone (flaccid) paralysis, which may be presumed in most areas to be due to poliomyelitis in the great majority of instances. This type of survey might best be carried out by a physician or orthopedic surgeon with experience of the rehabilitation of paralytic poliomyelitis, aided by physiotherapists with experience of muscle grading. Records should include the severity of paralysis, based perhaps on the number of limbs involved and the ability to walk and to perform manual tasks appropriate to the economic status. Records should also include the age of the patient and the age at onset of paralysis.

In place of a special survey of this kind it may be possible in certain areas such as a large town to set up improved reporting systems. Attention should be directed primarily to paralytic cases which should always be reported separately if non-paralytic cases are also reported. The latter should be reported as aseptic meningitis and not as poliomyelitis. This is certainly a worth-while measure and would help to provide a neucleus of improved reporting which might gradually be extended to other areas and eventually to the whole country. However, as far as poliomyelitis is concerned this approach will not lead to quick results. The incidence of the disease is so irregular that several years must pass before trends or mean incidence become clear.

Before turning to more expensive survey methods involving laboratory tests, mention should be made of an index which in a number of continental areas, but not as a rule in islands or other isolated communities, has shown an inverse correlation with the mean incidence of poliomyelitis. This index is the infant mortality rate. This inverse correlation was first described by the author at the Third International Poliomyelitis Congress, in the proceedings of which full details may be found. The data were submitted to the WHO Expert Committee on Poliomyelitis which came to the following conclusions - "Premonitory signs that may suggest the imminence of epidemic poliomyelitis include first an improving trend in infant mortality. When infant mortality falls below a rate of about 75 per 1000 live births, it is common to find that poliomyelitis rates begin to increase above that of 3-4 per 100,000". The Committee continued "a second feature which may presage a shift in the direction of increased activity of poliomyelitis is the appearance of cases of poliomyelitis in older children as well as in infants. More specifically, when 20% or more of the paralytic cases are recorded in children over 10 years of age, such an increased activity of the disease can be looked for". This is an important sign but depends on the availability of reliable statistics regarding the age incidence of the disease over a number of years. Nevertheless special efforts should be made to initiate the accumulation of such data now since it will prove invaluable in following trends in the future.

Serological surveys have been done in many countries to obtain data on the immunity status of the population which might assist health authorities to decide when and to what population groups vaccination should be applied. The author carried out a rather extensive review of this approach which may be found in the proceedings of the Fourth International Poliomyelitis Congress, and which was presented to the Expert Committee. The Report of the Committee contains the following section and in Annexes 3 and 4 of the Report guidance on performing surveys and a summary of the data may be found:

"SEROLOGICAL SURVEYS

"Health authorities are frequently interested in assessing the immunological status of a population, especially at the present time when decisions must often be made as to whether, when and to what extent vaccination programmes should be carried out.

"For this purpose useful data may in certain circumstances be obtained from serological surveys. It should be stressed, however, that serological surveys have limited intrinsic value in themselves and the time, labour and money expended for their performance are only justified if the information gained cannot be obtained by simpler means. In countries where reliable health statistics exist, a good picture of the immunological status of a population may be obtained from the paralytic attack rates in the various age-groups, especially if these are available for periods of one or more decades. Valuable information may also be gained by properly designed clinical surveys looking for residual paralysis such as that carried out by Paul in Cairo.

"Such data are, however, not available everywhere and in many countries the accuracy of such data as exist may be doubted. In these circumstances a serological survey of the prevalence and age distribution of poliomyelitis antibodies, if properly carried out, will provide an estimate of the susceptibility of a population. It must be emphasized, however, that the occurrence of an epidemic is not only dependent on the immunological status of a population, but also on a number of other factors, some of them related to the virulence and amount of virus in circulation and others still poorly understood.

"Both neutralizing and complement-fixing antibodies can be assessed. The latter are of a less permanent character and may serve as an indication of recently acquired infection. Neutralizing antibodies on the other hand express the integrated experience of a population with poliomyelitis virus in the past and reflect its immunological status. Generally it is observed that antibodies to the three antigenic types of poliovirus run a

similar course in the different age-groups. Because of the probable sharing of antigenic components among the types of poliovirus, antibodies to type 2 alone may be of more than type-specific significance.

"In order to provide a valid answer a survey of neutralizing antibodies should fulfil certain criteria (see Annex 3, page 50).

"The Committee reviewed a report on the results of serological surveys collected by WHO from WHO Regional Poliomyelitis Laboratories, members of the WHO Expert Advisory Panel on Virus Diseases, and from many other virologists (see Annex 4, page 54).

"The Committee noted that with few exceptions the results of these surveys were much as would have been expected from current views on the epidemiology of poliomyelitis, and that there was satisfactory agreement between these results and the age distribution of paralytic poliomyelitis when reasonably reliable information was available for the latter. It was noted that few cases of paralysis were to be expected when the percentage without antibody to any one type fell to the region of 20%. However, it was clear that the difference in the pattern of immunity in different population groups within a country, particularly between different socio-economic groups, was almost as great as that observed between countries in widely different stages of economic development. It was considered that this greatly limited the usefulness of these surveys, since only the most elaborate and therefore the most expensive surveys could be expected to give an accurate overall picture of the immunity status of the population.

"Nevertheless, it was agreed that, where other data were lacking or unreliable, useful information might be obtained, even though it might be only approximate. The Committee considered that, apart from special investigations for specific purposes, surveys should be regarded as a poor substitute for data accumulated through accurate reporting of the paralytic disease.

"Situations where surveys may still be considered as essential are: in areas where vital statistics are not available, in islands and other isolated communities where the immunity status is unpredictable, and in epidemic conditions showing unusual features difficult to interpret."

It is evident that careful consideration of the potential practical value of the result of a serological survey is wise before such an expensive undertaking is begun. However, in many countries where poliomyelitis is not a severe problem to the country as a whole at the present time, suitable designed surveys on sections of the population can help to detect those population groups in need for protection; for example, upper socio-economic groups and populations in some isolated areas where the acquisition of natural immunity may be delayed until an age when paralytic consequences are more likely to follow infection. Sequential sampling of population groups over the years can enable a delay in the age of acquisition of antibody to be detected, such an upward shift being a warning of increased likelihood of epidemic poliomyelitis.

It must however, be stressed that all these ways of estimating the present situation and of attempting to project into the future are fallible. There are still many factors in the epidemiology of poliomyelitis which are quite unknown. In recent years there have been a number of severe outbreaks in areas where, according to the indications mentioned above, epidemics woul.. have been thought to be most unlikely. It is not known why these occur. It has been postulated that the appearance of an invasive strain of heightened virulence for the central nervous system may be responsible. This is possible, even probable, but unfortunately there is no way at present of detecting and identifying strains with this potentiality.

Cost of vaccination against poliomyelitis

This may be divided into two parts, the cost of the vaccine (either manufacture or purchase) and the cost of administration and surveillance of the programme.

The cost of commercially available inactivated vaccine varies considerably with the manufacturer and ranges usually between $5 and $10 for 10 doses. Three injections, 2 primary injections and one reinforcing dose, are essential and in some countries a fourth dose is now recommended. Taking 3 injections, the cost of vaccine to immunize 10 persons ranges between $15 and $30. Thus if 100,000 young children are to be immunized, the cost will exceed $150,000 for vaccine alone. To this must be added administrative and organizational costs of giving 300,000 injections and of organizing a surveillance or evaluation service which would seem to be an essential part of such an expensive programme to ensure that the results justify the cost and effort. It must be stressed that unless the full course of 3 doses can be given, the results will be disappointing. It is not considered wise to attempt to economize by using the intradermal route. The results may not be satisfactory.

The decision whether to purchase or to manufacture vaccine will depend on the facilities and technical competence at hand. Due to the special manufacturing requirements for this vaccine, adaptation of existing buildings will often be unsatisfactory and large capital expenditure may be required for a special building. Such an undertaking would seem unwise at the present time in view of the developments regarding a live vaccine which may become available in the near future. The technical skill needed for the manufacture of a safe and effective vaccine is of a very high order and is not to be acquired in a short period of training. It will be necessary to consider therefore whether there are skilled virologists (or, if not, bacteriologists) available who can be diverted from their present work into this new field after an additional period of training. In addition to professional staff, a large and well-trained technical staff is needed, but it is emphasized that production of poliomyelitis vaccine must always be closely controlled by full-time professional experts. The dangers of technical errors are considerable.

With regard to the live attenuated vaccine rapid developments are taking place and the promising progress has been reviewed in the paper by Dr Sabin. However, there are still many unsolved problems, many of which are outlined in the summary of the recent Conference on Live Poliovirus Vaccines, convened jointly by WHO and the PAHO in Washington in June. A copy of this is annexed.

Among other problems not detailed in that summary is the establishment of minimum requirements for the manufacture, safety and potency testing of the vaccine. These are of great importance for the live vaccine, since, unlike the inactivated vaccine, there is not the protection of the added formalin against extraneous contamination, either from outside or by viruses occurring naturally in the monkey kidney tissue cultures. One of these, the so-called B virus, is known to be highly lethal for man and the effect of many others is unknown. In spite therefore of the promising progress, it is at present unwise to be precipitate in the application of this vaccine as a routine public health measure. A great deal of work is in progress and it is to be honed that data enabling sound decisions to be taken will be available in the next few months. Even then, however, we will have much to learn regarding the application of the vaccine if that is considered the proper course.

Conclusion

A safe and effective vaccine against poliomyelitis exists, but it is expensive and can only be applied where the incidence of poliomyelitis demands it and where other demands on the health budget permit it. This can only be decided after a careful study of local circumstances and indications have been given as to how certain aspects may be studied.

When vaccination is decided upon it must be applied in the recommended way if success is to be ensured. If production facilities do not already exist it is probably wiser to purchase vaccine than to construct new facilities in the present stage of rapid development.

The live vaccine is not yet considered ripe for routine application. Its application under certain circumstances in carefully designed trials with close surveillance may be considered, but each case should be studied individually. New information is expected within the next year which may enable more definite decisions to be taken. In the meantime in many countries it would be wise to study how the present situation regarding paralytic poliomyelitis may be better defined so as to be in a position to decide on action should a live vaccine recommended for routine use become available.

The Report of the Expert Committee (T.R.S. No. 145) contains much useful information and recommendations for tackling these difficult problems.

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Encl.