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THE EARLY TREATMENT OF POLIOMYELITIS

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The present and quite exceptional prevalence of acute poliomyelitis has stimulated interest in two questions that concern medical administrators and clinicians alike: At what stage should the orthopaedic treatment of the disease begin, and what are the essential features of that treatment? In this short paper an attempt is made to answer these questions in the light of our present limited knowledge of the disease. Difficulties in diagnosis will not be considered, nor the treatment of what might be called the visceral manifestations of poliomyelitis, such as pharyngeal and respiratory paralysis and disorders of micturition, the treatment of which is a matter of urgency and is, or should be, reasonably well understood. The problem is what should be done for paralysed skeletal muscles.

The Period of Isolation

The choice of three weeks as the period of isolation is arbitrary. It cannot be otherwise, since the duration of infectivity is very variable; it may last only a few days after the onset of paralysis so far as the oropharynx is concerned, whereas the patient may continue to excrete virus in the faeces for as long as ten weeks after the disease has declared itself. However, the choice of three weeks as the isolation period seems to be justified by experience, though it may be rather too long. The ideal arrangement would, no doubt, be to admit the patient immediately to a hospital, generally an orthopaedic or children's hospital, in which he could remain for the duration of his treatment; complete continuity of management would then be possible. But there are certain practical objections. Many orthopaedic and children's hospitals have long waiting-lists, and in some places their difficulties are now aggravated by a shortage of nurses. Conditions, particularly in orthopaedic hospitals, are often unfavourable for nursing infectious cases, and in some hospitals young probationer nurses are employed on the understanding that they will not come into contact with cases of infectious disease. At least one-third of all cases of poliomyelitis either fail to develop significant paralysis, or such paralysis as appears is transient and clears up within a week or two; these fortunate patients require no special treatment, and to that extent the beds they occupy in a special hospital would be beds wasted. On the whole, therefore, it seems best to admit cases of poliomyelitis to a fever hospital in the first place, on the clear understanding that someone skilled in the treatment of the disease—which generally means an orthopaedic

surgeon—is asked to see the patient within twenty-four hours of admission and is given a free hand to order such treatment as he deems necessary.

The Clinician's Duty

There is still no proven specific treatment for poliomyelitis. Recovery depends on the spontaneous return of function in such of the anterior horn cells of the spinal cord and brain stem as have not been completely destroyed by the virus. The clinician has a twofold duty. First, he must maintain the peripheral parts in the best possible condition, so that when voluntary control is returning recovery will not be vitiated by contractures and other harmful changes that have taken place in muscles, tendons, and joints during the period of paralysis. Secondly, if recovery is not early and complete the patient must be taught to make the best possible use of such return of power as is vouchsafed to him. All the arts of physiotherapy and, at a later stage, brace-making and reconstructive surgery may be required to assist the patient in his return to something like useful activity. But it cannot be too strongly emphasized that no one has ever cured a case of poliomyelitis. All that we can do is to help or hinder a process of recovery that is quite outside our control.

There has been and still is an idea abroad that paralysed muscles, especially those whose nerve supply has undergone Wallerian degeneration, are in a peculiarly delicate state. No less an authority than Sir Arthur Keith (1919) has written:

"What are the best means of maintaining in health a muscle which has just become paralysed . . . ? Let us look at the condition of such a muscle: . . . the vital contents of every cylinder begin to break up, degenerate, and be absorbed. . . . We wish, as far as possible, to prevent the breaking-up of the muscle cylinders and to maintain intact their original condition so far as we may. Massage applied to the delicate and broken organization of a crippled muscle seems to me calculated to help in the work of destruction. If in any crisis of surgical treatment rest is necessary, it is in the early stages of degeneration of a paralysed muscle."

Splints are applied with almost religious fervour; the limb is handled with great tenderness, stretching of the paralysed muscles being avoided at all costs. The fact is that even a denervated muscle does not degenerate; the changes so graphically described by Keith do not occur. A paralysed muscle retains its essential structure and some electrical

excitability for a number of years after all voluntary power has been lost. There is a progressive loss of bulk, which is very rapid at first, but this is due to a true atrophy; even this shrinkage can be partially prevented by appropriate electrical stimulation, provided that one uses strong enough stimuli of long duration and treats the muscle at least daily (Jackson, 1945). What is needed to keep a paralysed muscle in good condition is not rest but controlled activity. Immobilization is harmful; activity is beneficial. The revolt against rigid splinting has been such that a number of authorities, of whom Miss Kenny is the chief, have condemned splinting outright. This seems to be going a little too far, for there is a place for splinting; it may be needed to prevent persistent stretching of a muscle beyond its normal resting length. Even normal muscle becomes seriously weakened if it is maintained in an overstretched position; how much more, then, is it necessary to protect a muscle which has lost its power of voluntary contraction?

On What Does Recovery Depend?

In poliomyelitis the situation is more complex than after injury of a peripheral nerve. Where there has been extensive destruction of anterior horn cells the muscles supplied by the affected segments of the cord are completely and permanently denervated; there is no hope of recovery, and no treatment is of any avail. But when we consider the state of muscles in which partial or complete recovery subsequently occurs it must at once be confessed that we are not fully seized of the exact nature of the changes that take place. There is, however, no doubt that recovery does not depend to any great extent on axonal regeneration such as occurs after repair of a divided nerve. In the first place, the really worth-while recovery takes place within six months of the onset of the disease, though some further and perhaps useful return of power may be observed between the sixth and eighteenth months. From what is known of the rate of axonal regeneration (1 to 2 mm. a day) it is obvious that at any rate the more distal muscles could not possibly be re-innervated in so short a time—if regeneration had to take place from the cord all the way out to the periphery. Furthermore, most of the muscles that recover well retain throughout the electrical excitability characteristic of innervated muscle. We may, therefore, conclude that those anterior horn cells that are capable of recovery are not usually damaged to such an extent as to cause axonal degeneration. Thus there is no basis for using electrotherapy.

At present our only course is to follow a procedure that long experience has shown to be sound. When the patient is first seen a chart should be made indicating the power of all affected muscles. The paralysis will be maximal within a week of the onset of the disease, and a chart made at this time will give a reliable picture of the extent of the damage. Most orthopaedic hospitals are now supplied with muscle charts, and there is general acceptance of the system of recording recommended by the Peripheral Nerve Injuries Committee of the Medical Research Council:

- 5=Contraction against powerful resistance
- 4=Contraction against gravity and some resistance
- 3=Contraction against gravity only
- 2=Movement only with gravity eliminated
- 1=Flicker of contraction
- 0=Complete paralysis

It has been suggested that the disturbance of the patient involved in making a complete muscle examination is harmful, but unless the paralysis is accompanied by severe pain (see below) so that the actual handling of the patient causes him distress there is no valid reason why the exami-

nation should not be made. It is, indeed, a necessary diagnostic procedure.

Splinting

The clinician is now in a position to determine what splinting, if any, is required. The aim is not immobilization but simply the avoidance of vicious postures and the overstretching of paralysed muscles. Let us consider the various parts of the body in turn.

(a) *Spinal and Abdominal Muscles.*—Unless the patient is an unruly little child a firm mattress is all that is necessary. A lively infant will need a plaster bed or a gas-pipe frame covered with canvas, and some sort of retentive harness may also be required.

(b) *Shoulder.*—The shoulder is largely dependent on muscles for its stability, and there is therefore much to be said for maintaining it in abduction if the abductors are paralysed, either with a pillow or, in the case of an unruly child, with a plaster or metal abduction splint. Contracture of the adductor muscles can develop very rapidly, which is another reason for maintaining the limb in abduction; 60° is sufficient, and neutral as to rotation.

(c) *Elbow.*—There are those who regard relaxation of a paralysed biceps as unnecessary, the patient being nursed with the affected arm lying alongside the body. Yet in this position the biceps is maintained at what is very nearly its greatest length, and it is therefore preferable to keep the joint in a position of 60° to 90° flexion when paralysis of the flexors is present.

(d) *Wrist.*—The long extensors of the wrist and digits are the only muscles that run any risk of being overstretched by improper posture, and a simple cock-up splint, which must not extend beyond the transverse palmar crease, will give all the support that is required.

(e) *Thumb.*—The metacarpo-phalangeal joint of the thumb, like the shoulder, is largely dependent for its stability on the short muscles that control it. A small plaster-of-Paris splint, like a shoe-horn, with its broad end lying over the lateral surface of the lower end of the radius and its narrow end curved round into the web between the thumb and index finger, will prevent overstretching of the paralysed thenar muscles.

(f) *Intrinsic Muscles of the Hand.*—From experience in the treatment of ulnar-nerve injuries I am convinced of the need for preventing overstretching of the intrinsic muscles, and there is no very obvious reason why they should not also be protected in cases of poliomyelitis where the long flexors are strong and therefore capable of producing a *main-en-griffe* contracture. All splints for the intrinsic muscles of the fingers are based on the "lumbricales cuff" first described by Kendall and Kendall (1939). A bar of plaster-of-Paris or metal crosses the palm at the level of the transverse crease and is joined to two transverse dorsal bars which lie parallel across the metacarpals and the proximal phalanges, the knuckles being exposed between them; the metacarpo-phalangeal joints are held in a position of about 45° flexion.

(g) *Hip.*—The hip should be maintained in the neutral position as in standing, though in small children it may be found more convenient to abduct both joints about 15°, in order to simplify nursing.

(h) *Knee.*—The chief danger here is stretching of the posterior capsule of the joint, and the knee should therefore be maintained in a few degrees of flexion.

(i) *Foot.*—The neutral position is correct.

In adults and older children the lower limbs are easily maintained in a proper position by small pads under the knees and a board to support the feet at right-angles, provided that the patient is not allowed to slip up the bed. The limbs should be protected from the weight of the bed-clothes by means of a cradle. Infants must be splinted; it may even be necessary to splint both lower limbs, when

only one is abnormal, in order to prevent the child from assuming a bad position. Plaster-of-Paris is not very satisfactory, since it disintegrates rapidly when wetted with urine. The best material is duralumin, and details for the manufacture of simple splints are given in full in a recent paper by Seddon, Hawes, and Raffray (1946).

Maintenance of Mobility

As soon as the patient is afebrile and free from pain the affected part should be put through a full range of movement at least daily, and if possible twice a day; in this way contractures will be completely prevented. Oedema of a grossly paralysed part is seen occasionally and is due to sluggishness of the lymph flow, which, in turn, is dependent on muscular activity. There is no more potent cause of stiffness; and there should, therefore, be no hesitation in elevating the swollen limb and persevering with frequent passive movements until the oedema has gone.

Irritative Phenomena

So far poliomyelitis has been discussed simply as a paralytic disorder. In recent years attention has been drawn, especially by Miss Kenny, to irritative phenomena which, at any rate in America, seem to be fairly common. These manifestations of poliomyelitis, to which it is believed by some that peculiar significance attaches, may be described briefly as pain and muscle spasm. Pain as an early symptom of poliomyelitis is commonplace, but persistent pain either in the spine or in the limbs is rare in this country, and was found in very few cases in two of the Colonies—Malta and Mauritius—where grave epidemics of poliomyelitis have occurred in recent years. Apart from the purely subjective sensory disturbances that so frequently mark the acute phase of the disease, one may distinguish three kinds of pain which can be elicited by the examiner: (a) a muscle which may or may not be paralysed is sometimes found to be tender; (b) a muscle may be painful when stretched; and (c) a muscle may be in a state of spasm which is accompanied by more or less pain. Spasm of the spinal muscles is universally recognized as an early feature of the disease, and is undoubtedly a manifestation of meningeal irritation, disappearing rapidly as the inflammatory process in the cord subsides. Spasm in the muscles of the affected limbs is, however, a very different affair and exceedingly hard to explain. By some it is held to be an essential feature of the disease; I have seen persistent painful shortening of a muscle in fewer than 10 out of 1,500 cases, although we were on the look-out for it, and in none was there unequivocal spasm in the muscles of the limb. However, we cannot altogether ignore the few cases in which muscles remain tender or are painful on movement, since treatment of these patients is beset with peculiar difficulties. If regular mobilization of the joints and muscles is withheld until pain has subsided it may then be found that contractures have developed which are exceedingly difficult to correct. Yet if mobilization is attempted early, pain will be provoked as the extremes of movement are approached and the mobilization will be ineffective. For these reasons active steps should be taken to relieve severe pain of whatever origin, even moderate pain if it persists for more than ten days. The frequent application of heat is valuable; immersion in a warm bath is an old and reliable remedy, and encasing the part in hot moist packs is useful, though it involves considerable disturbance of the patient and is messy and time-consuming. At any rate, no effort should be spared to relieve the pain so that early mobilization of the limbs may be carried out.

An entirely different approach, for which Ransahoff, of New York, makes considerable claims, is the relief of pain associated with muscle spasm by the injection of curare. It is believed that muscle spasm or the slight shortening of muscles that causes pain when the muscle is stretched is due to irregular activity of the muscle, which in turn is caused by disordered action of certain of the affected anterior horn cells. However, it seems very doubtful whether curare is completely effective in relieving these painful muscle disorders, for in order to obtain full muscle length powerful and often exceedingly painful stretching of the muscles is necessary, and the method has not commended itself to those who have seen Ransahoff's patients under treatment. There is still much to be found out about the nature of the sensory disturbances in poliomyelitis and of disorders of muscle function other than simple paralysis.

Essential Features of Treatment

The essential features in the early treatment of weak and paralysed muscles in poliomyelitis are as follows:

1. Early determination of the extent and degree of muscle weakness. The extent of the paralysis should always be ascertained at about one week after its onset and then at intervals of two weeks until two months after the onset. Observations at intervals of a month will then be sufficient, and after six months at intervals of two months.
2. Maintenance of the paralysed part in what one may call a sensible position—the term “physiological position” is hardly apposite—should be undertaken from the first. This is the only reason for the application of splints.
3. In order to prevent stiffness of joints and contracture of muscles the affected part should be put through a full range of movement at least once a day, this treatment being started when pain has subsided or 10 to 14 days after the onset of paralysis, whichever period is the shorter.
4. If pain—either muscle tenderness, pain on stretching a muscle, or true muscle spasm—persists beyond this time, or if it is very severe in the early stages of the disease, relief may sometimes be obtained by the application of heat; and it will then be considerably easier to carry out the movements that are so essential for the maintenance of the limb in a healthy condition.

Re-education of muscles during recovery is outside the scope of this article.

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The Third Conference of Tuberculosis Workers, recorded in *Transactions of the Third Tuberculosis Workers' Conference held in New Delhi, March, 1945* (New Delhi: Tuberculosis Association of India, 20, Talkatora Road; Rs. 4), was sponsored by the Tuberculosis Association of India. Lieut.-Gen. Hance, D.G.I.M.S., quoted the estimated tuberculosis death rate in Indian cities as 200–450 per 100,000 population. Dr. P. V. Benjamin proposed a five-year plan to provide each three-million unit of population with a clinic, a subclinic, and a 50-bed hospital, and each Province or major State with a large hospital, clinic, and training centre—accessibility rather than climate to influence the siting of institutions. A long-term programme was also outlined. Speakers discussed tuberculosis experience in wartime, mass radiography, chest surgery, and the teaching of tuberculosis work. The proceedings emphasize the vast size of the tuberculosis problem in this subcontinent: estimates of the number of active cases among its 400 million inhabitants were variously given as 2½ and 20 million. The smallest long-term target of 500,000 beds for tuberculosis should be considered against the present 75,000 hospital beds of all kinds. However, one cannot but feel that the most powerful factors in bringing about a decline in tuberculosis rates in the new India would be a general rise in living and nutritional standards resulting from radical changes in its industrial and agricultural economy, the liquidation of illiteracy, and the training of increasing numbers of doctors and nurses.