THE TREATMENT OF SPINAL PARAPLEGIA AT STOKE MANDEVILLE

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The English National Spinal Unit at Stoke Mandeville is a unique centre in that it was the first hospital in the world where the treatment of spinal injuries was studied comprehensively and a completely new approach evolved. It began early during the Second World War with the increased number of spinal injuries. Dr. Ludwig Guttman, with difficulty, gained permission to put some new ideas into practice and began with one patient. The centre had, at the time I was there in 1951-1952, increased to one hundred and twenty beds in the hospital, had its own staff of doctors, surgeons, nursing staff and orderlies, and, of the eighteen physiotherapists employed at the hospital, sixteen worked full time in the unit. Between all the members of staff, from Dr. Guttman down, there was a tremendous spirit of cooperation and enthusiasm which inspired all the patients as well and made us all into a happy, purposeful, and single-minded team. Each physiotherapist had eight to ten patients to treat, and this, with weekly lectures on various aspects of spinal injury treatment by the medical staff, attendance at the initial examination of patients, and on ward rounds, meant a very full programme of work for all. The hospital itself was well constructed for paraplegic needs. It was built on one level with necessarily broad corridors to cope with high-speed wheelchair traffic. All stepped entrances had been converted into easily graded ramps. A handle on a chain hung over all beds, in all garages, toilets, and baths, to facilitate the patient's transfer without assistance from one place to another.

Paraplegia, of course, results from a partial or total lesion of the spinal cord, and paralysis of voluntary and involuntary muscles ensues, and connection with the central nervous system is permanently lost, except for sympathetic reflexes over which the patient has no control. Therefore, if the lesion is complete, there is complete loss of all voluntary muscle power, all sensation, and dysfunction of bowels and bladder.

At the onset it is important to stress the basis of the new medical, surgical, and physiotherapeutic approach to treatment. Hitherto, paraplegics had been extremely neglected and were left to lie flat on their backs until some kidney disease, or advanced bed sores, left them wide open to pneumonia or some other fatal illness, and no effort was ever made to rehabilitate them in any way.

The approach to the new treatment was the direct antithesis to this. The entire unit was organized on the basic principle that apart from paralysis of the lower half of the body, a paraplegic is fit in body and mind, can be trained to almost absolute independence, and is perfectly capable of returning to active employment when the best use is made of his active muscles and of such reflexes as are left to him.

The principles underlying all paraplegic physiotherapy are:

1. The establishment of a new sense of posture by overdevelopment of the muscles remaining active in the upper trunk and shoulders, so that the patient can balance himself, sit erect, and move freely in his wheelchair for any activity. Particular attention is paid to *latissimus dorsi,* which, with its cervical innervation from segments six, seven, and eight, is always relatively unaffected and, having a wide thoracic and lumbar attachment, is particularly suitable to train as a substitute for *erector spinæ* when establishing a new sense of balance.

2. The prevention of flexion contractures of the hip and knee joints which usually result from spasticity.

3. The reduction of the spasticity by intensive bodily activity as soon as this is practical.

For the purpose of clarity, the discussion will be divided into three parts. First, the

treatment of a patient from the time of admission directly after injury, until his discharge to employment; that is, the outline of a case uncomplicated by poor nursing, bladder infection, or deformity—in fact, the ideal case. Secondly, the more typical case of long standing, presenting all, or a number of, these complications. Thirdly, discussion of the handicaps expected to be present in lesions at different levels.

Upon admission, if there were no fragments of bone at the fracture site which could do further damage, laminectomy was not performed. Plaster jackets were not used, as they lead almost invariably to bed sores, and the ordinary hard hospital mattresses were avoided for the same reason. The patient was sandbagged into position, lying on a mattress composed of large blocks of sponge rubber about twelve inches deep and about the same width. In this way a gap could be left beneath the patient for the downward shoulder and arm, and another at the hip for the greater trochanter, so that there was no pressure when the patient lay on his side. He was turned every two hours, day and night, by a team of orderlies who held the patient's body quite rigid so that there was no possibility of strain at the fracture site. Turning was kept up throughout his hospitalization at slightly extended intervals, every three or four hours, the patient turning himself as soon as the fracture was sound. For this purpose a handle on a chain was fastened over each bed.

Treatment of bladders was also quite novel. It was found that in a matter of weeks, as a rule, reflex tone returned to the bladder so that it emptied automatically. The suprapubic catheter was avoided, and except for intermittent catheterization during the establishment of reflex action, no catheter was necessary and a rubber urinal, which fitted over the penis and was strapped to the thigh, was all that was needed. In the case of women patients, reflex action was particularly important, as it is a great problem to fix catheters satisfactorily.

Physiotherapy was started as soon as the initial shock of the accident had passed. Timing one's visit to the period when the patient was lying supine, two physiotherapists would give gentle bilateral resisted adduction of the arms in the first attempt to encourage over-action of the *latissimus dorsi*. This was slowly increased, great care being taken to ensure that no movement took place in the patient's spine.

From the time when union became sound, passive movements were given through full range daily to all the joints of both lower limbs, extension and abduction of the hip, and extension of the knee. Firm, slow pressure, applied often by two physiotherapists, was needed to overcome flexion and adduction spasm, and the movement was repeated six to eight times for each joint. Care was essential, especially with long-standing cases, as osteoporosis always occurs. This is thought to be due to hyperæmia, though the cause is not yet established with certainty, and fractures therefore occur very easily. The maintenance of full hip extension is particularly important for erect standing later on. Simultaneously, the first steps towards getting up began. From lying flat the patient was raised up on increasing numbers of pillows, and for longer hours, and finally was able to be propped into the sitting position without "blacking out". He then progressed to sitting over the side of his bed, the back and feet well supported, the patient gripping his knees with his hands. This might be possible for only half a minute at first, but as he slowly became accustomed to it, the first steps in learning balance began. This was taught by instructing the patient to lift one hand away from his knee. When this became simple, he could then bend the hand to the shoulder and attempt some simple arm bending and stretching; starting with "sideways stretch" is the simplest, as this requires no adjustment of body weight forwards or backwards.

About this time the patient is permitted to get up and wheel himself about in a rubber-upholstered wheelchair. He is then able to come to the physiotherapy department and to intensify his efforts. Balance is progressed with the patient sitting over the side of a low plinth, feet supported, in front of a mirror. Progression

is made to bilateral arm movements, the "forward stretch" being done by rounding the spine and keeping the body weight balanced equally in front of and behind the centre of gravity. The "upward stretch" entails an even greater rounding of the spine. Naturally, all attempt at correct posture is impossible with all or most of the normal postural muscles out of action.

Further progression is made by removing the mirror while the arm movements are done, then by holding sandbags in either hand, by keeping the eyes closed, and, finally, with all these accomplished, to do all the arm movements with the body held to one side. Trunk turning and bending are added with the hands first on the shoulders, then at full arm stretch; catching and throwing a basket-ball from an increasing distance to either side of the patient, and above his head, is also very useful as a balance exercise.

While learning this, the patient attended gymnasium for daily practice in indian club swinging. He worked on his *latissimus dorsi* with resisted bilateral adduction exercises done either with spring resistance or with increasing numbers of sandbags strung over pulleys attached to the ceiling.

The part of *erector spinæ* which remained active was strengthened by using the Guthrie Smith suspension apparatus for spring-resisted back or hip extension exercises. From the long sitting position, the feet were supported against a plank, the knees kept firmly in extension by a broad strap, and a six-inch sling was passed behind the patient's waist and fastened by increasing numbers of springs at shoulder level to the uprights of the apparatus near the patient's feet. Total suspension was also used for "latissimus" exercise. Here the patient, suspended in the supine position, held onto the couch above his head to fix the thorax and swung the lower half of the body from side to side. It was found that with extremely spastic patients this exercise, if continued for between half-an-hour and one hour, relieved spasm considerably by tiring it out, which was of great use when practising walking. If the body were held at the end of the sideways swing, the *latissimus dorsi,* working with reversed origin and insertion, could be exercised intensively.

Walking was commenced as soon as balance was fairly good. Overlapping front and back plaster of Paris leg slabs were made and bandaged on firmly. They stretched from ankle to upper thigh and were used with toe-raising springs. These were replaced later by knee-locking callipers with bucket tops. This was the only form of brace used.

A walking race was used at first, and later under-arm crutches. The four-point method of walking was used with a few exceptions, who found the swing-through style easier.

Standing, using extension spasms of the back and legs for support, was another useful form of balance exercise and a stretch for the hip flexors. The patient stood in the race and encouraged the spasm by hyperextending the back and hips sharply. The physiotherapist applied pressure to keep the feet together and on the floor, and to prevent the knees from giving way if the spasm did not last. With patience the patient was often able to achieve sufficient balance to stand thus, holding the rail with one arm and moving the other about freely.

It was found that really heavy activity did much to tire the spasms so that they finally became fairly controllable, so every form of suitable sport was encouraged to the utmost. Archery, javelin throwing, rope climbing, and basket-ball were practised and thoroughly enjoyed by all fit patients. Tournaments held against outside teams of unhandicapped men often resulted in a win for the paraplegic teams.

In the later stages of treatment the question of future employment arose, and those men with aptitudes in a particular direction were taught boot-repairing, watch-repairing, some form of bench work, trained as draughtsmen, or assisted with accountancy courses.

The others were assisted to find factory employment. If their homes were no longer suitable and could not be adapted to wheelchair needs, several aftercare homes existed in industrial areas which made excellent hostels from which the men could

journey to their jobs each day by motorized wheelchair or hand-controlled cars which were provided by the authorities.

The outline given above is of the treatment given to a patient who received proper attention from the time of his injury and who had no complications. In the majority of cases more complicated problems presented. Many patients located perhaps years after injury and only then brought to Stoke Mandeville were primarily cases for specialized nursing and surgery. Almost all had pressure sores, which were sometimes so extensive that joints were involved. Bladder and kidney infections were almost universal and very often the more spastic patients had severe hip contractures. Some with flaccid paralysis were absolutely rigid in the joints of the back and legs.

Straight away their pressure sores were treated by excising any slough, and were dressed by packing them with tulle gras or dry boracic gauze. The wounds were then sealed from the air completely with adhesive tape and were redressed every one to three days. The improvement was dramatically quick. Photographic records were kept of the progress of most of the bigger pressure sores, and even those in which the sacrum had been completely exposed were often healed in three to four months using this treatment. Surgical closure or skin grafting was employed in some cases.

When a suprapubic catheter is used there is constant drainage of urine through the catheter and the bladder is never filled, so contraction inevitably occurs, sometimes to the point where the bladder has a capacity of only a few ounces. The open incision also renders the patient particularly susceptible to infection of the kidneys. Every effort was therefore made to redilate the bladder by clipping off the catheter for increasing lengths of time each day, thus forcing the bladder to fill, or by using a method of tidal drainage whereby the catheter was attached to a U-tube fixed at a given height above the urethra so that the bladder emptied automatically, but only when it had reached a pressure equivalent to this height. If this proved successful, the incision was closed, and afterwards a rubber urinal was all that was needed.

Fractures were a complication against which the nursing staff, orderlies, physiotherapists, and the patients themselves were constantly on guard. They could occur easily with such porous bones and, being without sensation, the patient might be unaware of any damage until the time came for him to walk. One of the greatest risks lies in turning the patient from one side to the other when the neck of the femur is liable to be subjected to great strain if the legs are adducted and insufficient support is present at the hip level. Once contracted, a fracture is extremely difficult to deal with. The bones are too porous to plate, muscle spasm often prevents immobilization of the site, and plaster of Paris splinting is impracticable due to the risk of development of pressure sores. A fracture once sustained is usually permanent and it means that the patient will be unable to attempt any form of standing.

The complications which particularly concerned the physiotherapy department were contractures and stiffness. As mentioned before, there were cases where patients had been left lying flat for many years and all the joints of the spine and lower limbs had become completely stiff. If by radiology it were shown that the joints were unaffected, gentle and persistent stretchings were given several times daily, often in the bath, until the full range was regained. With spastic paralysis the tendency was to develop severe contractures of the hip flexors and adductors and of the hamstrings and calf as described previously. Daily passive stretchings were given these joints and often needed considerable force applied by two physiotherapists, one to each leg for bilateral abduction, while for hip extension the patient lay on his side holding tightly to the bed, one physiotherapist applying forward pressure to the buttocks while the other, hands clasped around the patient's thigh, slowly increased backward pressure until the spasm was overcome and a full range stretch given. Dorsiflexion and knee extension were done with the patient lying on the back. Sometimes if the spasms proved intractable an alcohol injection was given into the spine. This resulted in

complete loss of all reflex spasm, but also ruled out the possibility of automatic bladder action and was used only in selected cases.

When able to attend the physiotherapy department, more intensive stretching could be applied. Three-point pressure in prone lying, using several pillows under the abdomen and the knees, and a broad sling pulled tightly over the buttocks, made a powerful hip stretch. In other cases vertical suspension was used. A padded corset which fitted over the lower ribs was attached by ropes over pulleys in the ceiling and the patient was hauled up until his feet cleared the floor. He would then hang for between half-an-hour and one hour. It was found that this stretch was also useful in that it tired the flexor spasm in the hips to the point of exhaustion, so that "hanging" was usually followed immediately by walking practice in the race.

So, to summarize the all-over picture: The importance of physiotherapy cannot be overrated, for, by the time the patient was ready to think about employment, his physical programme often took from four to five hours daily. After passive movements first thing in the morning the patient dressed himself, then put in up to two hours in the physiotherapy department. After lunch indian club swinging took half-an-hour, and archery, basket-ball, or other sports were played for about an hour, out of doors if the weather permitted, if not, in the gymnasium or archery range.

Spinal cord lesions at different levels produce varying problems as regards nursing and physiotherapy. Patients with high cervical lesions of the top three cervical segments stand little chance of survival without active phrenic or intercostal nerves to suplement the vagus in operating the breathing processes.

Lesions between the first cervical and third thoracic segments are perhaps the most tragic. Those with the injury between the third and the fifth cervical segments lose the use of the arms completely and so depend utterly on outside help for the smallest attention. They are unable to feed themselves or even turn the pages of a book. I feel personally that it is unfortunate for them to survive the initial accident. Should the lesion be at the sixth or seventh segment, the patient will have lost triceps, the wrist flexors, the short muscles of the hand, and the invaluable *latissimus dorsi,* so that the unopposed pull of deltoid, biceps, supinator, and the wrist extensors causes the arm to be held in shoulder abduction, flexion and supination of the elbow, with the wrist and fingers in extension. The patient is unable to propel a wheelchair or use crutches, and has to be strapped erect in his wheelchair and wheeled about by somebody else when he is out of bed. For all these patients physiotherapy is confined to the prevention of contractures in the arms and legs by daily full-range passive movements, though the unopposed pull of the active arm muscles makes this almost impossible.

If the lesion occurs between the level of the second thoracic and third lumbar vertebræ, the picture is a very different one, for, with the full use of the arms and an active *latissimus dorsi,* the full programme, as described above, can be embarked upon.

In any lesion above the junction of the second and third lumbar segments the cord itself suffers injury, so the paralysis can be flaccid or spastic, depending probably on whether the extrapyramidal fibres are left intact. Below this level, however, the *corda equina* only is severed, so the resulting paralysis constitutes a lower motor neurone lesion and is always flaccid. Unlike any cervical or thoracic lesion, no uncontrolled spinal reflexes remain, making it impossible to establish automatic bladder control, and a catheter is always necessary.

As seen from the discussion, a physiotherapy department used for paraplegic treatment has to be modified from the usual layout. An adequate number of Guthrie-Smith suspension appliances are necessary and plenty of mobile full-length mirrors. The walking races in use at Stoke Mandeville were made of pairs of hurdles on heavy bases with bars of adjustable height. Callipers and plasters were kept in a rack within easy reach of a patient seated in a wheelchair. The gymnasium next door was fitted with several heavy-weight ropes attached to the ceiling and used for rope climbing. It was large enough for the basket-ball matches which

were often played between physiotherapists and patients. The archery range had been set up in a disused ward and bows of varying strengths were used. A swimming pool was being built at the time I left.

I feel keenly that a centre of this type in Melbourne would be of inestimable value in the adequate treatment of our own paraplegic cases. I would like to stress the fundamental precept that a patient with a spinal injury should never be considered as a chronic invalid, but, with proper treatment, he should be self-supporting within approximately one year of the accident.