SOME CONSIDERATIONS ON THE TREATMENT OF SPASTIC PARALYSIS.

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CONSIDERABLE misconception still seems to exist with regard to the treatment of upper motor lesions, and it is all too common to have patients sent into hospital suffering from some form of spastic paralysis, who give a history of having been ordered long courses of massage and electricity. It would seem that for many doctors the word 'paralysis' is intimately associated in their minds with the words 'massage' and 'electricity', and they apparently do not remember what these two admirable therapeutic measures are supposed to do. The passage of a series of interrupted currents through a muscle causes the muscle to contract, and in so doing shortens the fibres of that muscle. Sherrington pointed out that a muscle at rest is not a muscle completely relaxed. He demonstrated that the ordinary resting length of a muscle was maintained by a partial contraction of the fibres which is called 'tone', and which depends on the integrity of the spinal reflex arc. If this arc is interfered with, the muscle loses its tone, and the fibres lengthen into their position of complete relaxation. In the higher animals, however, this postural tone of a muscle at rest does not depend on the spinal reflex only, for if the spinal reflex is cut off from its connections with the cortex, its tone is at once altered, and it is found that its tonic contraction increases so that the fibres become shorter. When an animal is operated on so that all connections with the cortex cerebri are cut off, certain muscles retain their tone provided the reflex arc is intact, at any rate after the first shock of the operation or disease had passed away. At first the whole spinal cord is so much affected, that the spinal part of the lower arc is interfered with and all muscles become atonic. In cases in which the spinal arc is isolated from its cortical connections, the tone is not the same as in normal conditions; and when disease or injury cuts off the spinal arc from communications with the cortex, we find that the tone in some muscles is increased, and that these muscles are the ones which are concerned in maintaining the normal erect attitude of the animal, i.e., the ones which counteract gravity. This tonicity of the muscles depends both on the spinal arc and on the integrity of another arc, the pre-spinal motor system.

When the spinal arc is separated from all the higher levels there

is no tone, but there may be activity. It is only recently that any work has been done in human beings to illustrate what happens when the spinal arc is left intact. The reason of this is that an injury so severe as to cut off complete connection with the brain, but retaining the connection of the limbs with the cord, is almost always quickly fatal. Head and Riddoch, by great attention to their patients, were able to ensure their survival, and found that, whereas in spinal animals activity was retained by the extensor group of muscles, so as to produce what is called an extensor thrust on stimulation, in man the activity is found to be retained for the most part in the flexor group. This may be explained as follows: One of the most primitive reflex actions an animal can exhibit is the drawing up of a limb or part of the body out of harm's way, and this involves action of the flexor muscles, so that for this purpose activity of these muscles is necessary. In man the spinal arc subserves this reflex chiefly, the reflex-action maintaining attitudes to counteract gravity, being almost entirely taken up by the pre-spinal system. In spinal animals, however, the spinal arc still has to perform this duty of counteracting gravity; hence the activity in the extensor muscles. Under such conditions of isolation of the spinal arc no voluntary movement at all is possible, but reflex movements may still be induced by stimulating various parts of the skin. This spinal reflex arc is controlled by higher arcs in the nervous system, and these belong to two great motor systems. Their action is to modify tonicity so that when either of them becomes negative by being cut out by disease, the spinal arc is left to itself and released from control, so that the muscles become hypertonic.

We must now consider these two motor systems, and they are interesting inasmuch as they correspond to the evolutionary change in the development of animals. Where an animal depended on more or less undifferentiated movements of a limb, such as is the case in the movements of the fin of a fish, it is found that only the older, or, as it is called, the pre-spinal system, is fully developed. This is concerned with the position of the animal in space, and with more or less indiscriminated movement. The other—the cortico-pyramidal system—is developed when the various parts of the limb have got to be used separately and discrimination established between the movements of the various groups of muscles. These facts can be illustrated by observing the effect of cutting out either of these motor systems. In some diseases the pre-spinal motor system is cut out, and in that case the spinal arc is under the control of the cortical system only, so that the tone and mode of action is modified. This pre-spinal system is composed of fibres which travel from the connection of the spinal arc up through the cord, and proceed by relays through the cerebellum and certain collections of cells, the most important of which is the

red nucleus, and down again through the cord to the anterior-horn cells of the spinal arc. It is not proposed at present to deal with the treatment of diseases interfering with this tract, or with both pyramidal and pre-spinal tracts.

When the pyramidal system is cut out it means that the pre-spinal and spinal arcs are allowed free play, and we find that certain muscles and groups of muscles will, as a result, show marked hypertonus, in consequence of their freedom from the control of the discriminating influences of the higher system. This higher system consists of relays of fibres passing up from the spinal arc to the cortex of the cerebrum, then down from the motor areas by the pyramidal tracts to the anterior-horn cells of the spinal arc. Interruption of this arc is seen in hemiplegia or spastic paraplegia due to interruption of the pyramidal fibres, and in certain wounds of the head which destroy the cells in the motor area. In these diseases we find that all the muscles connected with the retention of the erect attitude will be hypertonic; and this will be found to involve practically all the muscles of the limbs, but specially the extensors; this is apparently untrue in the upper limbs of man owing to their altered function as a result of their being freed from the duty of locomotion; but this does not alter the general law.

In man, the arms are primitively used for grasping, embracing movements which require the action of the flexor muscles, and hence we find that they are the ones which become hypertonic. As a result of this hypertonicity and the loss of discrimination in movement, the limb moves as a whole in a stiff spastic manner and the patient cannot execute fine movements, such as writing.

From the above, however, it is evident that in cases of spastic paraplegia muscles are already hypertonic, and further stimulation by electricity or massage, as usually given, will increase their tone and make matters worse. It may be admitted at once that in long-standing cases of hemiplegia certain muscles which are overcome by the hypertonic groups become wasted and atonic, and in such cases massage to these muscles may be useful, providing great care is taken in estimating which are the atonic muscles and only dealing with these; for it frequently occurs that a limb may be wasted from disuse, and certain muscles appear small which on investigation are found to exhibit intense hypertonicity. In these cases electricity is always contra-indicated, as it is impossible to confine the action of the current to the atonic muscles, for it will always spread through and throw the hypertonic muscles into action.

A very important point in the treatment of spastic cases is, by the use of proper splints, to prevent the weaker muscles being stretched and rendered atonic. Contractures are the result of neglecting

this precaution. Splints at first should be used all the time, but later may be discarded during the day. They should be made of some light material, and various forms have been found useful. Where contraction has already occurred, a light celluloid splint moulded to the limb, which can be padded to extend the fingers of the hand gradually, is useful; but where there is only a tendency to contraction, the most useful type of splint for a hand would seem to be a leather gaiter tightly fitted over the forearm, and moulded to reach the heads of the metacarpals held in a slightly extended position. Five steel springs are fastened to hooks attached to the back of the gaiter at the level of the wrist, and are fixed to other hooks on corresponding leather finger-stalls, fitting over the 2nd and 3rd phalanges of the fingers and the 2nd phalanx of the thumb. In this way the fingers tend always to be held in extension, but can be flexed for such movements as the patient is capable of. The difficulty with more fixed splints is that, although the patient is capable of flexor movements, he cannot get his fingers out again, and the springs will do this for him. Where there is marked paralysis of the supinator muscles with consequent hyperpronation of the forearm, an extension of the splint above the elbow may be used. This is supplied, as suggested by Dr. Carleton, with a universal joint, which can be screwed up tightly in varying positions of supination so as gradually to relax the spasm of the pronators. For the dropped and inverted foot which is so frequently met with in spastic paralysis, most success has been attained by a simple leather gaiter fitted to the leg, attached to the top of which are two springs, one fixing to a loop in the centre of the boot over the heads of the metatarsals, the other to the outside of the boot at the level of the fifth toe. With this help the hemiplegic can often walk with fair comfort, provided he learns always to step off with the weak foot and not bring the good foot too far forward. In this way he prevents the toe scuffing the ground in an effort to bring it forward when left behind.

So far as active treatment is concerned, it is essential to attempt to induce relaxation of the hypertonic muscles and encourage the action of their opponents. On general principles, if the lesion is at all severe, treatment of the hand is very disappointing, and where there is a loss of sense of position of the fingers, any attempts are practically hopeless. Where, however, contracture has been prevented from going too far by appropriate splints, and there is not too great interference with the discriminated movements of the various groups of muscles, a good deal can be done. The first essential is to encourage the patient to make the effort to move his fingers, and nothing will bring this about so well as an actual demonstration that they can be moved with moderate freedom. If the hand is placed in as hot water as can

be borne, either in a whirlpool bath or in an ordinary hot-water bath, and the patient is encouraged to make his movements while in this bath, much progress will be made. At first the efforts at movement may be helped by judicious passive movements on the part of the masseuse, but it can never be too strongly impressed on both the patient and the masseuse that the hand is not being placed in the hot water simply to cook, but to work. Too often one finds a patient dangling his hand in a bucket of hot water, reading the paper, or carrying on more or less interesting conversations with his masseuse. This is an utter waste of time and water. Directly there is any possibility of such movements being carried out, the patient must be got to do things with his injured hand. Writing, using a fork, doing up his buttons, modelling with plasticine or clay, should all be systematically taught, and it can never be impressed on the patient too much or too often that the disablement of his hand is the reason for using it, not for leaving it hanging by his side. This treatment will do good even in cases which are entirely organic; but there is almost always a functional element added to the disability, arising from the conviction in the patient's mind that his hand is of no use. The active treatment will remove this, and will even improve the organic condition in an astounding way. This is especially the case where the injury has been cortical, from accident or gunshot wound, and where the area actually destroyed is often small, although there has been widespread disablement owing to the temporary oedema of the cortical tissue.

With spastic paralysis of the leg much more can be done. A patient can get about even though his gait is clumsy, and the absence of finer discriminations of movements are not so important in the lower limb as they are in the upper. The same principles must be adhered to, relaxation and re-education, and again hot water is a most useful adjuvant. In the case of the lower limb, however, hot water is not so easily supplied because in the ordinary bath there is not sufficient room for free movement. As is well known, the adductors are the muscles which are chiefly under spasm, and there is never enough breadth in the bath to overcome this by proper movements. As a rule it is difficult to get a large enough bathing-place with sufficiently hot water, as the water must be at the temperature of 102° – 104° to be of any use in relaxing spasm. I have been fortunate in being able to give this method of treatment a good trial in Bath, because we have a bath some 30 ft. square and 4 ft. 6 in. deep, in which the water comes up at the natural temperature of 104° . This gives an absolutely ideal exercising ground for patients with spastic paralysis of their legs. At first the patients are supported in a sling from the roof consisting of three bands, one passing under the occiput, another

under the arms, and the third under the hips. This can be raised or lowered by means of a pulley, so that a perfectly helpless patient can have his limbs immersed in this hot water and yet retain his head comfortably above it. Passive movements of his legs are carried out, and he is encouraged to kick out in any direction he can. Two advantages are gained: first, the hot water relaxes spasm to a maximum; and secondly, the action of gravity is counteracted, owing to the support given to the limb by the water. Patients who have been practically unable to move their legs in bed are very soon able to execute quite strong and agile movements in the water. As they improve, the slings round the hips and the head are removed, and, supported by the attendant and the sling round the arms, they are encouraged to stand and start walking movements. Soon they dispense with the sling altogether, and walk round the bath supported without difficulty by the attendant. Exercising in this hot water is hard work, and should not be persisted in for more than twenty minutes, and probably not more than three times a week. Experience has shown that a course of about fifteen to twenty baths is sufficient. In one case which is quoted below, which was that of a robust patient, and in which I went on as long as improvement resulted, over 100 baths were given, more or less continuously. By this time he was complaining that his muscles were getting weak and that he was easily fatigued, but within a fortnight after stopping them he was better than ever.

As in the case of the hand, the intelligent co-operation of both patient and attendant is necessary. Merely lying in the hot water will do no good, and a great deal of the success depends, first on the desire of the patient to co-operate and to get well, and secondly on the personality of the attendant, who should give the encouragement that is needed. It is not claimed that this hot-water swimming bath is a specific for the treatment of spastic paraplegia or hemiplegia; but where it can be carried out easily, with sufficient room and sufficiently hot water, I have no hesitation in claiming that it is the ideal way of dealing with this common and rather wearisome disability.

The following cases illustrate the use of this method of treatment:—

Case 1.—Disseminated sclerosis.

A. V. M., age 29. Wassermann recorded as positive in 1918, but the condition was made worse by salvarsan treatment. Wassermann negative on admission, when he was walking with crutches, with marked spasticity and difficulty of separating feet. Usual symptoms of disseminated sclerosis. Was discharged from hospital able to walk with one stick, and to undertake clerical work.

Case 2.—Gunshot wound of spine at level of 8th dorsal vertebra.

A. M. V., age 26. Marked weakness of lumbar muscles, for which he was given spinal support. On admission could walk about a hundred yards. On discharge could walk nearly a mile. Capable of sedentary work. Went home to South Africa.

Case 3.—Disseminated sclerosis.

W. G. K., age 34. Usual symptoms, with spastic ataxic gait. Gait improved to a certain extent, but disease progressive, and improvement was not maintained.

Case 4.—Hemiplegia after diphtheria.

R. M., age 20.—Usual signs of hemiplegia. Arm was much improved. After treatment he was able to hold a fork, could feed himself well, and just sign his name. Gait considerably improved, but his general condition was poor. Was never able to walk very far.

Case 5.—Gunshot wound of spine of 10th dorsal segment.

W. F. C., age 24. Marked spasticity, with scissor gait. On discharge could separate his feet 22 in., and could get into the upright position, though with difficulty. He could walk by himself for short distances, which had been impossible previously.

Case 6.—Hemiplegia, the result of a stroke.

T. B., age 44. Considerable amount of osteo-arthritis. Treatment improved his walking slightly, but he was discharged very little relieved.

Case 7.—Typical case of disseminated sclerosis. with markedly ataxic spastic gait.

S. J. H., age 22. Although disease was definitely progressive when admitted to hospital, he improved considerably later, the gait becoming less ataxic and less spastic. Still under treatment, and is now able to walk nearly half a mile, with difficulty.

Case 8.—Spastic paraplegia following myelitis.

G. L., age 46. Admitted to hospital bedridden. Unable to separate his legs at all. Being a robust man, he continued having baths and re-education while improvement persisted, and eventually had over a hundred baths. Can now walk five miles and separate his feet 30 in., and, with support, 53 in.

Case 9.—Gunshot wound of spine in 5th dorsal vertebra.

W. W., age 29. Admitted with extreme spasticity and severe pains. As a result of prolonged treatment spasticity has enormously improved. He can walk for a mile, and has very little pain. Can separate his feet 29 in.

Case 10.—Disseminated sclerosis.

T. D., age 37.—Improved with treatment. The spasticity decreased, and the patient is shortly going to start on sedentary work.

Case 11.—Disseminated sclerosis, with marked mental deficiency.

J. W. B., age 31. At first improved enormously under treatment, so that from being practically helpless he was able to walk relatively well. Suddenly, after absence from hospital during Christmas, he relapsed,

developed bed-sores, and was unable to stand. Still under treatment, and is again improving.

Case 12.—Attack of (?) spinal encephalitis lethargica.

M. A., age 46. May, 1921: progressively developed symptoms simulating disseminated sclerosis till July, 1921, when she began to improve. Signs of pyramidal interference were still present, with loss of sense of position. Progress was very slow till the end of November, 1921. She was got up on crutches and began the hot-water swimming bath. From then progress was rapid, and in January, 1922, she was able to walk with two sticks for 300 yards. Still lacks the sense of position of legs, but there is comparatively little spasticity. Plantar reflex had previously been extensor, but has now become flexor.