ON
NEURITIS OF THE BRACHIAL PLEXUS.

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THE pathology of peripheral paralysis is still involved in so much obscurity, and its treatment so frequently unsatisfactory, that I venture to hope the following contribution to the same may be thought worthy of the attention of the Fellows of this Society.

The case which forms the groundwork of the following communication is that of D. D—, a girl, æt. 16, who was admitted into the infirmary for epilepsy and paralysis under my care, on July 18th, 1870, with paralysis of the right upper extremity. She had been in very good health before the present affection came on. She first menstruated at the age of 15, and had continued pretty regular ever since. In April last she suddenly began to complain of pain and numbness in the right hand and arm; the next few days she experienced a loss of power in those parts; the fingers appeared white, and the skin peeled off. The weakness of the muscles gradually became more marked, and in about ten days from the commencement of the affection she had completely lost the use of the whole upper extremity. She now attended as an out-patient at one of the London hospi-

tals, where she was treated with bromide and iodide of potassium, nux vomica, belladonna, and, later on, with the syrup of iodide of iron and cod-liver oil. For the relief of the pain, liniments of aconite and chloroform, subcutaneous injections of morphine, chloral, and a blister to the neck, were used, and Faradisation was resorted to daily for a month in order to relieve the lost power; yet (to use the words of the physician under whose care she was, and who has kindly given me these particulars) "she only got worse from first to last;" and she was then sent to the infirmary, where she was admitted under my care.

On examining the patient, it appeared that there was complete paralysis of motion and sensation of the whole upper extremity, no voluntary movements of the arm and shoulder being possible, and no touch, pricking, pinching, or any other mechanical irritation being in the least degree perceived by the patient. The muscles of the arm were not wasted, and the temperature of the limb was not lower than that of the left arm. Faradisation of the skin, and of the nerves and muscles of the shoulder and arm, likewise proved ineffectual; but when I applied a powerful continuous current of Daniell's battery to the arm, the patient exclaimed that she felt sensations of heat, pricking and tingling in the arm and fingers; and the muscles, more especially the flexor muscles of the fingers, responded to the current by sluggish, yet plainly perceptible contractions. Any lesser galvanic power than sixty cells of the battery did not produce any effect, while under ordinary circumstances a current of twenty cells causes not only decided sensations of heat and tingling, but also muscular motion.

The curious fact that under certain circumstances one form of electricity will produce an effect on a paralysed limb, while another form of it will prove absolutely ineffectual, was first pointed out ten years ago by Baierlacher, of Nuremberg; and has since then been experimentally studied by Erb, Ziemssen, and other observers. It appears from these investigations that as far as such alterations of excitability are concerned, nerves and muscles obey totally different laws; that soon after

an injury to a nerve has taken place, either by mechanical violence, or by rheumatic, gouty or syphilitic effusions, the excitability of the nerves appears to be completely destroyed, not only to the induced but also the continuous current; while the muscles lose their excitability only to the induced and not to the continuous current. The important practical conclusion to be deduced from these facts is that it is of no use to treat cases of this kind with the handy little machines furnishing an interrupted current, as this has no influence on nerves and muscles thus affected, but that the continuous galvanic current alone should be resorted to for their cure.

In the present case I gave no medicine whatever. The patient had already been treated therapeutically by a very able physician, who had used all the remedies upon which we look with most confidence in the management of such affections, yet the result had been absolutely *nil*. On the other hand, the general health of the patient was so good that no medicines were required on account of that. All that was done was, therefore, a systematic daily application of the continuous current to the suffering extremity for about five minutes each time. The result of this treatment has been most satisfactory. After four applications sensation returned in the paralysed limb, so that the patient was again able to perceive touch, pricking, pinching, &c., just as well as before the commencement of the affection. The paralysis of motion proved more stubborn; but after seven applications the girl was able to move her fingers. The treatment was continued for another fortnight, at the end of which the patient could not only move all her fingers, but also flex and extend the wrist. I then discharged her, as I was anxious to see whether she would continue to improve on the treatment being suspended, or whether she would remain in the same condition. It might have been said that a process of natural cure had set in; that the progress the patient had made was synchronous with, but not owing to, the galvanic treatment; in fact, that the good results hitherto obtained were not *propter hoc*, but *post hoc*.

Six weeks after her discharge the patient presented

herself again at the infirmary, and it was then found that she was absolutely in the same condition as when she had left it. She had not gone back in the interval, but she had made no progress whatever, the arm and shoulder being just as useless as before. The supposition of a natural process of cure could not, therefore, be entertained ; and as the patient and her parents were very anxious that the treatment should be resumed, she was readmitted on September 27th. The use of the continuous current was now recommenced, with the result that in a very few days a further decided improvement took place ; the patient soon became able to move the hand, arm, and shoulder in all directions, and to grasp things with some force. She was, however, not discharged until the power of the right arm was in all respects quite equal to what it had been previous to the commencement of the affection. The recovery of power went on steadily from the periphery to the centre, the fingers being the first and the shoulder-blade the last to regain it. The patient was sent home on November 28th perfectly recovered.

The present case raises some interesting questions in diagnosis. What was the actual nature and seat of the paralyzing lesion in this patient ? Was it a case of cerebral, spinal, or peripheral paralysis ? Could it be due to hysteria, lead-poisoning, or other causes which we know to produce palsy of motion and sensation ? These questions I shall now proceed to consider.

Cerebral paralysis is extremely rare in persons of the age of our patient ; it generally comes on quite suddenly, not gradually, as in the present case, where the invasion of the complaint was protracted over ten days. Again, cerebral paralysis almost always affects one side of the body, the face and the leg as well as the arm, while in this case the cerebral nerves and the lower extremity did not at all suffer. Cerebral paralysis is only very rarely accompanied with complete anæsthesia ; for most patients suffering from it, although they may be completely deprived of the power of motion, retain sensation in a more or less considerable degree. All these

circumstances, taken collectively, speak strongly against the cerebral origin of the palsy ; but one more remains to be mentioned, which puts the matter completely at rest, and this is, that *in cerebral paralysis, whatever may be the extent of the loss of voluntary power, the nerves and muscles always retain their excitability to Faradisation* ; and in those cases where there is any inflammatory irritation in the brain, the paralysed muscles answer even more powerfully to the Faradic current than those of the healthy limb—a fact to which the late Dr. Todd was the first to direct attention. There is no exception to this rule ; and the absence of Faradic excitability in the present case was quite sufficient to make us reject the idea that in our patient the brain was the seat of the paralytic lesion.

Was it then a case of *spinal paralysis* ? To this question we may also return a negative answer ; for if there had been disease of the upper portion of the spinal cord or its meninges sufficiently severe to cause total paralysis and anæsthesia of the whole upper extremity, the intercostal muscles and the lower extremity would have participated in the affection. Another circumstance which speaks against the supposition of spinal paralysis is that in the earlier stages of such an affection the muscles do not lose their excitability to Faradisation.

Paralysis occurs sometimes in consequence of pathological changes which have taken place in the *cervical sympathetic nerve* ; but in cases of that class, which are very rare, there are always considerable alterations to be noticed in the nutrition of the face, viz., increased vascularity of the skin, heat and hyperæsthesia of the same, constriction of the pupil, protrusion of the eye-ball, &c., all of which were absent in the present case.

Nor could the paralysis in this instance have been due to *lead-poisoning*. There was no evidence to show that this girl had ever been exposed to the injurious influence of lead ; there was no blue line on the gums ; she had never suffered from colics or obstinate constipation ; and what is even more important the general aspect of the palsy in her case was

entirely different from that which occurs under the influence of lead. In lead-palsy both arms are affected, the right one generally more than the left; and it is almost exclusively the extensor muscles of the hand and forearm which suffer, while the flexors either escape completely, or only become weakened to a moderate degree.

Whenever lead-palsy is severe, there is great deformity of the forearm, the back of which is hollowed by atrophy of the extensors, while the wrist drops. In the present case, however, although the paralysis was complete, the arm retained its shape and plumpness; there was not one particular set of muscles which suffered more than another, but all the muscles of the whole extremity were indiscriminately affected.

Some recent authors have affirmed that there is no such thing as *hysterical paralysis*; but their clinical experience must have been very limited. Cases of hysterical paralysis without any structural lesions whatever are, indeed, by no means rare, but the present case was certainly not one of hysterical paralysis. The girl had never shown any symptoms of hysteria; moreover the invasion of hysterical palsy is quite different from that which was observed in this case, as it almost always comes on quite suddenly, after a violent mental emotion, while in this case the progress of the loss of power was protracted over the space of ten days. Hysterical paralysis almost always affects either the vocal cords or the lower extremities, giving rise to aphonia and paraplegia, and only very rarely occurs in the upper extremity. This girl, however, had never lost her voice nor been unable to walk. Moreover, in hysterical paralysis, the motor nerves and muscles retain their excitability to Faradisation for years after the commencement of the affection, while in this case it was lost within a few weeks from the beginning of it.

Paralysis occurs sometimes in consequence of *disease of the urinary organs*; but this is always confined to the lower extremities, which have never suffered in our patient. Moreover, the urinary organs were and always had been in perfect health in the present instance.

The question might now be asked whether the case was one of nervous or muscular disease? This admits of a ready answer. The fact that not only motive power but also sensation was completely annihilated, speaks sufficiently for some part of the nervous system being in fault; moreover, there is no muscular affection which takes away motive power without at the same time altering the bulk of the extremity. In Cruveilhier's disease or wasting palsy the degree of paralysis is always proportionate to the extent of muscular atrophy that is present; while in Meryon's or Duchenne's disease the paralysis corresponds to the degree of muscular hypertrophy which is noticed. In the present case the bulk of the suffering limb was exactly the same as that of the healthy limb.

The last question we have to consider as far as diagnosis is concerned is, whether the girl was *malinger*? It is well known that girls, especially of the age of this patient, are given to deceitful practices in order to excite wonder and interest, and that they will continue the deceit for months and even years (*e. g.* the Welsh fasting girl). But this question is likewise disposed of by the results of the electrical examination. Malingerers may have sufficient control over themselves to bear, without flinching, severe pain, as produced by pricking, pinching, or burning; but it would be absolutely impossible for them to resist the influence of an induced current of high tension in making their muscles contract. This influence is irresistible where the nerves and muscles are in a healthy condition, and the question of shamming may therefore be dismissed.

After excluding all the various affections which we have been considering, we are led to the result that the affection must have been due to a pathological lesion of the anterior branches of the four lower cervical nerves, which form the *brachial or axillary plexus*. This plexus imparts motive and sentient power to the whole upper extremity; it animates the rhomboid muscles, the serratus anticus, the supra and infra-spinatus, the subscapularis, the anterior portion of the latissimus dorsi, and all the flexors and extensors, pronators and supinators of the

arm and hand. Not one of these muscles had escaped the paralyzing influence, while muscles in their immediate neighbourhood, which are animated by different sets of nerves had remained in perfect condition. Thus for instance the trapezius and the sterno-cleido-mastoid muscles were in no way impaired, for the motion of the head, forwards, backwards, and laterally, had always been quite easy; nor did the *cervical plexus*, formed of the anterior divisions of the four upper cervical nerves, suffer; for there had never been the least interference with respiration, showing that the phrenic nerve, which arises from this plexus and animates the diaphragm, had escaped the paralyzing influence. Moreover, the skin of the back of the head, the neck, and the ear has never lost its sensibility—a circumstance which excluded an affection of the sentient branches given off by the cervical plexus, which animate the skin of the parts just mentioned. On the other hand, the skin of the arm, from the acromion downwards, was totally anæsthetic, while the sensation on the shoulder-blade was blunt although not quite gone. That the skin of the shoulder-blade should have preserved a certain amount of sensibility is easily explained by the circumstance that it receives sensitive influence, not only from branches of the brachial, but also from such of the cervical plexus which, as we have already seen, did not participate in the disease.

It would be difficult to determine in which point of its transit the brachial plexus was diseased. When I examined the patient there was no thickening or tenderness perceptible anywhere in its superficial course, which could have led me to fix upon the precise seat of the pathological lesion; but as not one of the motor or sentient branches of the whole plexus had escaped the paralyzing influence, the seat of the disease must have been at some point of the plexus before its entrance into the axilla.

It now remains to determine the nature of the pathological lesion which had affected the brachial plexus. We may at once exclude injury to, and tumour pressing upon, the plexus, of neither of which was there any history or evidence. Inflammations affecting the plexus may be of a syphilitic,

gouty or rheumatic character ; and as there were no symptoms of syphilis or gout in the patient, we are led to the conclusion that the case was one of *rheumatic neuritis of the brachial plexus*.

Whether such a disease with its sequelæ may be influenced by any purely medicinal treatment is extremely doubtful. The patient had, before she came under my care, been treated for more than two months, by a very able physician, with those remedies which we look upon with most confidence in the management of such affections ; yet there was no improvement whatever. The disease, however, yielded readily to a judicious application of the continuous galvanic current. Sensation, after having been completely lost for about four months, returned within a few days from the commencement of this treatment. Motion was recovered more slowly, but steadily, and in exact proportion as the galvanic treatment was continued. The fact that no improvement whatever took place during the six weeks which the patient spent at home, between the two periods of her stay in the hospital, while she immediately improved each time the galvanic treatment was resorted to, is sufficient to prove that the recovery was not due to the unaided efforts of nature, but was really owing to the influence of the particular plan of treatment which was adopted.

The precise mode of action of the continuous current in cases like the forgoing is not yet fully understood. It appears, however, probable that its effects are of a complex nature ; and it is only one of them with regard to which we may speak with absolute certainty. This is, that the application of the current may prevent granular disintegration and atrophy of the paralysed muscles by making them contract. The experiments of Dr. John Reid have shown that muscles which are separated from the influence of the nerve-centres, will, if frequently caused to contract, preserve their nutrition much longer and more thoroughly than those which remain quiescent. The induced current cannot prevent atrophy of the muscles in cases like the one I have related, because it is unable to make them contract. It is, therefore,

a great boon that we possess, in the continuous current, an agent which will, if properly applied, cause muscular contractions under any circumstances as long as the muscles have not utterly lost their normal structure.

But this is evidently not the only beneficial effect which galvanisation produced in the present case. We have seen that, by its means, sensation was within a few days restored to its normal condition. It is, therefore, evident that the current re-established the conductivity of the sentient fibres of the brachial plexus, which was completely lost previous to its application. The current must have done the same thing, although more slowly, with the motor branches of the plexus, since the mere causation of muscular contractions, although useful for preventing muscular atrophy, could never have restored that nervous influence to the muscles which enables them in the normal condition to respond to the orders of volition. It is, therefore, necessary to assume that the current contributed to the removal of the rheumatic effusion, which pressed upon the plexus and thereby rendered it unable to fulfil its function. By effecting dilatation of the blood-vessels of the affected parts, the current obviously enabled them to take up and remove into the general circulation, pathological effusions which by their presence impeded the conveyance of the nervous influence to the distal parts of the nervous district. Whether there was in the present case actual destruction of nervous matter, such as occurs through mechanical injury or tumours and whether galvanisation promoted or accelerated its regeneration, it would be difficult to determine. But looking at the rapidity with which sensation was re-established, it seems more rational to assume that the inflammation, although sufficiently severe to cause entire loss of function, had not proceeded to absolute destruction of the nervous matter, but had caused effectual compression of the same, which was removed by the catalytic effects of the continuous current setting free the nervous force, which had been rendered inactive through interrupted conduction,