LECTURES ON THE SURGERY OF THE SPINAL CORD AND ITS APPENDAGES.

Delivered before the Royal College of Surgeons of England.

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CONCLUDING LECTURE.

PATHOLOGY OF PARAPLEGIA IN VERTEBRAL CARIES.

CARIES of the spine may affect either the bodies of the vertebrae or their arches, the former being very much the commoner of the two conditions; and here we find that paraplegia may be produced in one or other of the following different ways:

1. That mere kyphosis is not usually competent to produce paraplegia is indicated, on the one hand, by the total want of clinical relationship between the extent of spinal deformity and the presence or absence of paralysis, and, on the other, by the *post-mortem* evidence that in these cases the spinal canal is frequently not narrowed but actually widened. Nevertheless, in a few rare cases the angular curvature has been found to cause compression of the cord, an example of this nature being recorded by Chipault.

2. Sudden paraplegia may result from fracture of carious vertebrae, examples being recorded by Park, Chipault, Kraske, and others; but this also is not a common condition, Kraske estimating cases of this nature to form but 2 per cent. of the total number of paraplegias depending upon vertebral caries. These cases also stand apart in their pathology, the essential lesion being here a fracture-dislocation; and, as Kraske—who has specially investigated the point—also suggests, laminectomy can here only do harm, in so far as it further weakens the already fragile spine, whereas the cord lesion is not due to simple pressure but to an irreparable crush, such as those to which we referred in the first lecture. Probably, therefore, the most suitable treatment of cases of this nature will be by extension and fixation of the spine.

3. Rare causes of paraplegia—causes so rare that we need not refer to them further—are the bursting of abscesses into the spinal canal, hæmorrhage into the canal, and the displacement of bony sequestra, which press upon the cord.

4. Charcot and others have shown clearly that the most usual cause of paraplegia is pressure by granulation tissue, which may or may not be caseous; this pressure being accompanied by irritative non-tuberculous pachymeningitis. The exact *modus operandi* of this pressure is, however, still open to question. The school of Charcot attributes the mischief to myelitis spreading from the point of pressure across the cord, but most recent observers do not accept this view, and it is certain that pressure alone (without myelitis) may cause paraplegia. The simplest explanation of such a condition would be that the pressure causes anæmia and subsequent degeneration of the cord, and in some cases we find the latter thinned and firm in texture, as if this were the true explanation. Kahler, Schmaus, and others, however, find that oedema and swelling of the cord is more common than constriction, and this condition is generally attributed to an extramedullary compression of veins and lymphatics, causing congestion and lymph stasis. Schmaus, somewhat hypothetically, attributes the oedema to irritation by the circulation of chemical products of the tubercle bacilli.

5. Lastly, in a few cases true tuberculous periarthritis is found within the cord, generally in association with tuberculous leptomeningitis, due to the perforation of the theca by the diseased process.

The condition usually found, both after death and during operation, is, however, certainly that of pressure by granulation tissue or abscess (that is, granulation tissue

which has softened) accompanied by non-tuberculous pachymeningitis and with either a small firm cord or a swollen oedematous cord. Local degeneration with secondary degenerative changes in the ascending and descending tracts follow. The pressure, it should be added, may be either directly backwards or lateralised, or, in cases of posterior caries, from behind forwards. Further, in a few cases no anatomical changes have been found, and in one of my operations the condition revealed appeared hardly sufficient to have given rise to the symptoms which were present although the latter rapidly recovered after laminectomy.

PROGNOSIS.

It is common clinical experience that recovery will usually occur after prolonged rest with fixation of the spine, but the limitations of ordinary hospital experience render it difficult to estimate in figures the frequency of this result. My own experience is that nearly all cases will recover if kept fixed in the recumbent position for a sufficiently long time, but the time required may be very prolonged, and I have at present under observation two patients who were totally paralysed for more than eighteen months, both of whom can now walk. In fact, of all the cases which I have met with, other than those submitted to operation, I know of only one in which the patient did not recover, or was not manifestly recovering when lost sight of. Myers has the most extensive statistics upon this subject with which I am acquainted, recording 218 cases of paraplegia due to caries, of which 3½ per cent. died of intercurrent diseases, 55 per cent. recovered under observation, and the remainder were either lost sight of, or had not recovered while under treatment, which, however, was not sufficiently prolonged to prove their incurability. It is, however, the less necessary to labour this point, as it is generally recognised that recovery is the rule in cases of this nature. On the other hand relapses are unquestionably common, and recovery is rarely, if ever, absolutely perfect, there being at least some exaggeration of the deep reflexes which, persisting through life, indicates the previous existence of the paralysis.

Cases in which the paraplegia is due to intramedullary tuberculous periarthritis can hardly be expected to get well, and those in which pressure has arisen from fracture of the carious bones are not likely to improve to any great extent. So also in some of the other rare varieties of paraplegia we have little to hope for, but, unfortunately, these are just the cases in which we can hardly expect any benefit from operative treatment.

INDICATIONS FOR OPERATION.

Assuming the prognosis to be thus favourable we are never called upon to perform laminectomy save under certain special conditions. It will not be argued that the recovery after laminectomy is more complete than that produced by Nature, and experience shows that relapses also are only too common after operation. The indications which appear to me to point to the necessity for operation are then as follows:

1. A steady increase in symptoms in spite of favourable conditions and treatment, as in the first and third cases which I am about to mention to you.

2. The presence of symptoms which directly threaten life. Thus, in my second case the secondary chest troubles were very grave. Intractable cystitis would fall into this category, but it is by no means common, and we can hardly agree with those who hold that the condition is in itself incapable of spontaneous recovery.

3. The persistence of symptoms in spite of complete rest is the indication which has been most commonly adopted, but, as we have already seen, such symptoms may persist for very long periods and then yield to absolute rest. It is, however, not improbable that, in a few cases, cicatricial pachymeningitis or, rather, peri-pachymeningitis may remain after the original pressure lesion has ceased to act, and may thus keep up paraplegia until the constricting tissue is removed. To this category Macewen's cases and my third case appear to belong.

4. In posterior caries (that is, in caries of the arches of the vertebrae), operation is clearly indicated, as here we can readily both treat the paraplegia and remove the whole of

the tuberculous tissue. Two cases of this nature are recorded by Abbe and by Chipault respectively, and both proved highly successful.

5. In my fifth case, the existence of severe pain, which was rapidly exhausting the patient, was regarded as an indication for surgical interference.

6. Lastly, children as a rule yield better results than do adults, so that, other things being equal, childhood may also be regarded as an indication for operation.

CONTRAINDICATIONS.

On the other hand, there are certain definite contraindications, such as the presence of active tuberculous changes in other organs. Macewen holds that we should not operate when there is pyrexia, which is almost tantamount to saying that we should not operate in presence of active tuberculosis. If, however, the pyrexia were clearly due to cystitis, then we might regard it as an indication for, rather than against, interference. Again, general meningitis (although fortunately very rare) will at times obviously be present, and will probably prove fatal whether we operate or not. To cases of fracture following upon caries we have already referred as unsuitable for laminectomy, and most paraplegias of sudden onset will fall into this category.

PERSONAL CASES.

Placing upon myself the limitations to which I have above referred, I have naturally but few cases of laminectomy in spinal caries to present to you, and these cases having been generally serious ones the results are by no means good, there being two deaths, one in which no improvement followed the operation, one of temporary improvement, and only one of perfect recovery. I can, however, hardly regret these statistics as I have had the satisfaction of seeing a very large number of cases recover without operation.

CASE I.—In the first case, to which I have to refer, the indication which led us to operate was the steady increase of symptoms in spite of the favourable additions to which the patient was exposed. The latter was a lad, aged 20, admitted to the Manchester Infirmary for tuberculous disease of the radius and of the cervical glands, and suffering also from pleurisy. While in hospital he developed weakness of the lower limbs and pain at the back of the neck; and at our convalescent hospital this rapidly progressed until he was totally paralysed. He was kept in bed with fixation of the head for a period of three months, during which time his symptoms were steadily aggravated. In August, 1893, the condition was briefly as follows: The lower limbs were absolutely paralytic and spastic. The trunk was paralysed, as were the hands. Extension of the wrist-joints was very feeble. The movements of the elbow were fairly good, with the exception of extension, and the shoulder-joints were normal. Sensation was very defective on the ulnar side of both upper limbs and in the trunk and lower limbs there was complete anaesthesia, except over the genitals and a part of the feet. Urine could be retained for about half an hour only, and the bowels were very constipated. In the neck there was slight rigidity and some pain. At the operation I exposed, before opening the vertebral canal, a soft tuberculous granulation tissue, projecting between the fifth and sixth cervical laminae on the left side. These two laminae, as also the arch of the fourth cervical vertebra, were removed and the theca thereby fully exposed, it being pushed backwards and to the right by the granulation tissue, which projected from the junction of the fifth and sixth vertebrae. On removal of this granulation tissue, we discovered a carious focus extending forwards, which was carefully scraped out. The wound healed by first intention. Sensation was restored throughout the body within the course of a few days; motor power returning more slowly. Five months after the operation there was little, if any, anaesthesia, and all muscular movements in the upper limbs were practicable, although those of the hands remained weak. The patient could, however, feed and dress himself, and wrote for me, as a sample, the letter which I now show to you. In the lower limbs the improvement was much less marked. Slight movements were possible at the feet and ankles. The knees hardly recovered at all, and the hip-joints remained paralysed. Urine could now be retained for from one and a-half to three hours. Unfortunately no further improvement occurred up to April, 1894, when a sero-purulent discharge appeared at the centre of the operation scar, leading obviously to a fresh growth of tuberculous tissue.

CASE II.—In my second case the patient was a boy, aged 8 years, who had suffered from cervical caries for at least a year, and had been under treatment in hospital during the greater part of that time. Paralysis took the form of a right-sided hemiplegia of nine months' duration. This had improved slightly after its first development, but had now been stationary for six months, during which time the patient had with difficulty recovered from an attack of broncho-pneumonia. The symptoms were rigidity of the neck with deflection of the face to the right; absolute paralysis of the right upper limb, except in the hand and fingers, which retained some slight power; loss of movement of the right side of the chest, with bronchial rales throughout; and weakness of the right lower limb, sufficient to make walking very difficult. He had no anaesthesia, and no vesical or rectal trouble. The general condition was bad, the patient looking thin and ill. A further period of three weeks' absolute fixation of the head and trunk in bed being followed by no improvement, laminectomy was determined upon. I removed the laminae of the axis,

and third and fourth cervical vertebrae from the right side, but discovered no abnormality, except a thin layer of lymph over the theca and slight adhesions of the latter to the bone. This layer was scraped away, the theca freed, and the wound closed. The latter healed by first intention and recovery was rapid, paralysis having practically disappeared at the end of two months. In November, 1893 (eighteen months after operation) the lad was at school, could walk and run well, and assist his father in the work of a carpenter; and with his previously paralysed arm he wrote for me the words which I show you upon this piece of paper.

CASE III.—A man, aged 25, had suffered from girdle pains for twelve months, paralytic symptoms for nine months, and total paraplegia for nine weeks. During the latter period he had been totally recumbent, but was getting steadily worse. He presented angular curvature at the sixth dorsal vertebra, total paraplegia with spasm, and almost total anaesthesia, exaggeration of the superficial and deep reflexes, and difficulty of micturition and defecation. The general health was good. The fifth, sixth, and seventh dorsal arches having been removed, there was revealed over the theca a tough membrane of about the thickness of a sheet of blotting paper, and the theca here presented a slight depression. The membrane was removed and the wound closed. Although the latter healed rapidly no improvement occurred during the next five months, at the end of which time the patient was lost sight of.

CASE IV.—My fourth case is that of a little girl, who had suffered from paraplegia due to dorsal caries, with occasional remissions, for some three years. The symptoms were those of almost total paralysis and anaesthesia, with incontinence of urine. The curvature was diffused, and occupied the middle dorsal region. Laminectomy revealed extensive softening of several vertebrae, and led into a very large abscess cavity, occupying the anterior aspect of the spine. The theca was obviously compressed. We tried to remove the tuberculous tissue but found that the patient was sinking, and were obliged to desist. She died in the evening of the same day from shock.

CASE V.—The fifth case was that of a man 40 years of age, also suffering from dorsal caries which was of nine months' duration. He had absolute paraplegia with spasm; anaesthesia, which was complete in the lower limbs, but had a fading upper margin; and total loss of control over the bladder and rectum. He suffered also from intense girdle pains, which, in spite of all medical treatment, were obviously wearing out his strength. After several weeks of rest and treatment I removed the arches of the sixth, seventh, and eighth dorsal vertebrae, which were adherent to a mass of firm cicatricial tissue surrounding the theca. To the left side we found a puriform focus. The cicatricial tissue was excised, and the roots of the sixth and seventh dorsal nerves were divided, in order to relieve pain. The theca being now gently drawn to the right an attempt was made to scrape away the caseous material situated on the anterior aspect of the vertebrae, and we thought that we had cleared out the whole of this abscess cavity. A drainage tube was left in the tuberculous focus, passing out by the side of the theca so as not to press upon it. After the operation there was no more pain, but the patient was very restless, removed his dressings the first night, and died apparently of exhaustion on the third day. At the *post-mortem* examination we removed the specimen which I now show to you, and which shows that we had by no means got rid of the whole of the tuberculous tissue, but that there is a large abscess in front of the vertebral column, opened by our posterior incision.

These cases, then, illustrate most of the conditions which are met with in the paraplegia of caries, as well as the dangers and some of the benefits of laminectomy, and I must now deal very shortly with published cases.

RECORDED CASES.

It is difficult to estimate the mortality of these cases; that is to say, how far the mortality is due to the operation itself, but I think that from 17 to 20 per cent. of deaths is not far from an accurate estimate. By far the most common cause of death has been shock or syncope; in a few cases myelitis or meningitis has proved fatal; in one the result was due to hæmorrhage into the cord; and in one to hæmorrhage from the vertebral artery at the time of operation.

As regards cure of the paraplegia, the immediate result has often been good, the symptoms improving even if they do not entirely disappear; but, unfortunately, recurrence is not uncommon, and in not a few cases a tuberculous sinus forms in the healed wound. This simply means that we have not fully cleared out the tuberculous tissue, and hence we are met by the usual difficulty in the surgery of tuberculosis, the difficulty of removing the disease by any conservative operation.

In the earlier cases no attempt was made at complete elimination of the tuberculous tissue, but in the modern and bolder operation, so strongly urged by Urban and Chipault, we may hope occasionally to succeed, although the probabilities of failure must remain considerable. The most satisfactory results have been those obtained in cases of peripachymeningitis in which the original tuberculous disease has ceased.

Lastly, it is to be remembered that, in some at least of the apparently successful operations, it is probable that the associated rest and fixation of the spine would alone have sufficed to produce the fortunate result. Thus, in a series of cases

such as those recorded by Mr. Lane, we can hardly doubt, having regard to our general clinical experience, that no small proportion would have recovered without laminectomy.

OTHER DISEASES.

With most of the other pressure lesions of the spinal cord which have been, or may be submitted to operation, I must deal very briefly. On this diagram I have placed a list of such diseases, and shall refer only to a few points in connection with each.

Diseases arising externally to the spine:

Hydatids
Aneurysms
Sarcoma and other growths

Diseases of the vertebrae:

Carcinoma
Sarcoma
Osteoma

Syphilitic deposits
Osteo-arthritis
Spondylolisthesis

Diseases of meninges or peri-meningeal tissue:

Tumours
Pachymeningitis
Hæmorrhage

Meningitis
Spina bifida
Spina bifida occulta

Diseases of the spinal cord:

Tumours
Syringomyelia

A few cases of hydatids have been submitted to operation, which has uniformly proved fatal, but the mortality has generally been due to sepsis, and there is no reason why in such cases we should abandon surgical treatment.

Aneurysms penetrating the vertebral canal are obviously utterly unsuited for operation.

Several cases are reported of tumours arising externally to the spine and penetrating to the vertebral canal. Thus, in 1889, I recorded a case of my colleague Mr. Wright, in which great relief was given by scraping out the intraspinal prolongation of a fibro-sarcoma of the neck. Five years later recurrence had occurred with return of paralysis, and laminectomy revealed a general infiltration of the vertebral arches, no benefit being derived. So far back, indeed, as 1856, Athol Johnstone successfully removed a lipoma situated over the sacrum, which had penetrated into the vertebral canal. Possibly, however, this may have been one of those cases of spina bifida occulta to which I shall refer immediately.

Growths of the spine itself have also been submitted to operation, there being several such cases in which the primary lesion was a sarcoma of the laminæ. Of these Mr. Davies-Colley's case resulted in recovery from the cord symptoms, but in all the growths have recurred.

The only rule, then, that we can adopt in cases of this class—that is, in cases of pressure lesions arising externally to the spine, or arising in the vertebrae themselves—is that pressure on the cord does not *per se* contraindicate operation, and we must be guided in our practice by the general rules of surgery.

With respect to tumours of the meninges I have nothing to add to the classical paper of Gowers and Horsley, except that there are now eight recorded cases, with four deaths, three complete recoveries, and one in which no benefit resulted, the latter, however, being a case in which symptoms had existed for twelve years at the time of operation. With these figures we can only conclude that laminectomy has here saved from certain death more than one-third of the cases.

As regards meningitis, I know of no operation in the form known as hypertrophic cervical pachymeningitis, but it seems not improbable that good results may be here obtained. White and Dercum operated in the cervical region in a case of complete paraplegia of rapid onset, finding only adhesions between the dura and pia mater. These being separated, complete recovery followed, but the true nature of the case is somewhat doubtful.

In a case of my own a man sustained an injury to the lower part of the spine at the age of 21, being then paralysed for a few weeks, after which he recovered completely, and worked as a collier for twenty years. He then began to suffer from increasing paresthesia and anæsthesia of the lower limbs, which resisted all treatment for two years. At the end of this time I removed the ninth, tenth, and eleventh dorsal laminæ, which were prominent and united by cicatricial tissue, revealing a dense felt-like tissue around the theca, the latter presenting no pulsation. This felt-like tissue was carefully removed and pulsation restored to the theca, which was freed from all adhesions. There was no improvement in the paresthesia, but sensation rapidly recovered. At this date, two years after the operation, the paresthesia is as much as before, but the patient can walk

for about half a mile, and is able to be on his legs the whole of the day, attending to a shop.

In two cases only do we find the records of operative interference for disease situated within the spinal cord. Church and Eisendrath report a case of removal of a sarcoma, which was situated in the posterior fibres, the patient dying from septicæmia. The growth was readily enucleated, but *post-mortem* examination revealed a blood clot extending almost transversely across the cord. It is unfortunate that in this case the septic accident did not allow us to judge of the ultimate possible result. Abbe has also punctured a syringomyelia without benefit.

SPINA BIFIDA AND SPINA BIFIDA OCCULTA.

I now wish particularly to call attention to an interesting group of cases which had hitherto received but little attention from the surgeon.

In 1876 Ogston reported a case of old spina bifida accompanied by perforating ulcer of the left foot, anæsthesia of the outer side of the leg and of the dorsal and plantar aspects of the foot, and diminished faradic contractility of the foot-muscles, all on the same side; that is to say, slight motor and sensory paralysis with a trophic lesion in the region which we have assigned to the lower lumbar and upper sacral nerve roots on the left side.

Some few years ago I recorded a similar case of cured spina bifida, with symptoms of much more extensive pressure upon the roots of the cauda equina, this pressure being in my case bilaterally symmetrical.

The following is a further example of the same nature. A man, aged 32, attended at my out-patient clinic, stating that seven or eight years previously he began to experience difficulty in passing water, this difficulty gradually increasing and being accompanied by constipation. Five years later a feeling of coldness and numbness commenced in the left great toe, and extended gradually to the outer side of the dorsum of the foot, and thence to the leg. A similar course of events followed in the right lower limb, and, later on, numbness was noticed on the back and inner sides of the thighs. Fifteen months before I saw him the man began to feel slight numbness in the penis and scrotum. A so-called "corn" then developed on the outer side of the right little toe, and this ulcerated and continued to discharge. Three years before my examination a swelling was detected over the lower part of the back, which swelling since had gradually increased in size. Over the lower part of the spine we found a soft elastic lenticular projection some 3 inches in diameter, extending rather more to the left than to the right of the middle line and having its upper border on a level with the fourth lumbar vertebra. This swelling was very slightly prominent; it had no hairy covering, and firm pressure upon it caused a vague feeling of discomfort, but no other symptoms. The gluteal muscles were flat and clearly atrophied, but presented no distinct paralysis. Anæsthesia was well marked, but far from complete, on the outer side of the legs and feet in the region of the distribution of the musculo-cutaneous nerve, especially on the left side. The back and inner sides of the thighs were much less sensitive than the front and outer sides, and the penis and scrotum presented distinct blunting of sensibility. On the outer side of the ball of the right little toe was an ulcer which had resisted treatment for more than a year. The commencement of micturition was difficult and delayed, and the act required much straining. The bowels were moved only with the aid of enemata. The sexual functions were unaffected. Unfortunately, this patient did not return to hospital, and we know nothing further of his condition.

In these three cases there can be no question that the nervous symptoms were due to pressure upon the cauda equina, and in the two first this pressure was doubtless due to cicatricial changes in the meningeal sac of a true spina bifida—a condition which also explains the not very rare association with the latter deformity of talipes varus, which arises from paralysis of the peroneal muscles. In the case last recorded it is, however, more probable that the swelling was due to a spina bifida occulta than to cicatricial changes in a meningeal sac.

The rare affection known as spina bifida occulta was described by Virchow in 1875 as a cleft of the vertebral canal, which had not gone on to the formation of a sac, but was limited to cleft of the spinous processes with separation of the laminæ, and since that time several cases have been reported by Fischer, Sonnenburg, Lücke, Recklinghausen, Brunner, Bergmann, Bland Sutton, Joachimsthal, and others, so that the condition is now well recognised clinically. It is common in these cases to find a marked hairy growth over the affected region, together with some paralysis and anæsthesia, of the cauda equina type, which I have already described. Trophic lesions especially appear to be common, perforating ulcer being described by Brunner, Recklinghausen, and Bland Sutton; and chronic osteitis of the metatarsus being present in Fischer's case. In Lücke's case, as in Joachimsthal's, there was luxation of the hip, which the former

regarded as being secondary to paralysis of the gluteal muscles.

The pathology appears to consist in the coexistence of a vertebral cleft with a hypertrophic condition of the adjacent soft parts, giving rise to pressure upon the cauda equina. Thus Sonnenburg found a deposit of fat beneath the area of hypertrichosis; and Recklinghausen found the cord surrounded and compressed by a myofibrolipoma. In the case which I have just described to you it is probable that the lenticular swelling was of similar nature, and the hypertrichosis usually met with may also be regarded as evidence of the local tendency to hypertrophy.

It remains to be added that there are also recorded examples of sacro-lumbar hypertrichosis in which no other symptoms of spina bifida occulta were present, but that in three such cases of Recklinghausen's a *post-mortem* examination revealed a slight fissure of the subjacent vertebral arches. In Fischer's case, again, a patch of hypertrichosis in the cervical region accompanied the typical sacro-lumbar spina bifida occulta, but no cleft was detected by palpation in the upper area.

Yet another example of this rare disease, which I met with in 1893, illustrates many of its peculiarities:

The patient was a gentleman, 57 years of age, who stated that sixteen years previously he had an abscess of the left foot, from which there came away some bony sequestra. Pain in this foot had continued ever since, occasionally with eruptions on the left great toe. Six months before I saw him two bullæ developed on the outer side of the left foot, being accompanied by great pain. The left leg below the knee was distinctly smaller than the right, the calf measuring an inch less in circumference, in spite of previous treatment by massage. The thighs were equally developed upon both sides, and no distinct paresis could be detected anywhere, nor were the rectal, vesical, or sexual functions affected. On the outer side of the sole of the left foot was a healthy scar, with a smaller one situated internally to it. Sensation was markedly diminished in the left leg as compared with the right, and the outer side of the leg was also distinctly more anæsthetic than the inner side. To a much slighter extent the left thigh was less sensitive than that of the right side, and here I was able to satisfy myself that the inner side of the upper part of the thigh was the most anæsthetic. Nowhere was anæsthesia nearly complete, but on the outer side of the left leg there was absolute analgesia to all ordinary stimuli, such as pinching, deep pricking, and the like. Pain was very great on the dorsum of the foot and the back of the leg and thigh, and it was for this pain that the patient sought advice. So far, then, the case resembled one of sciatic neuritis on the left side, but on examining the back we found the condition which is shown in the appended engraving, that is to say, a lenticular swelling, similar to the one which I have already described, accompanied by a curved tail-like process of skin, which was surrounded at its base by a few hairs. It was also obvious that the spinous processes of the first sacral and probably of the last lumbar vertebra were not developed.

Case of spina bifida occulta, from a photograph, showing the lenticular prominence over the sacral vertebra, with a tail-like process of soft tissue about three quarters of an inch in length; at the base of this process were a few fine hairs, some two inches in length. The posterior superior spinous processes of the ilia are indicated by pieces of paper.

That cases of this nature—that is to say, either the cicatrices of old spina bifida or the analogous spina bifida occulta—should be amenable to surgical treatment appeared *primâ facie* probable, and an excellent result was obtained in a case of old spina bifida, which I saw several times with my friend the late Dr. Ross, and which was operated upon and recorded by my colleague Mr. Jones some three years ago.

It appears to me not improbable that the cases mentioned by Athol Johnstone and Holmes as lipomata penetrating to the

spinal canal may have been of similar nature; and Témoin also records the successful removal, from the lumbar region of a child, of a congenital lipoma, which, although it penetrated to the spinal canal, had caused no nervous symptoms.

Chipault records yet another case of Zavaleta's, in which a similar lipoma had penetrated the dura mater, but in which removal was followed by fatal meningo-myelitis.

Lastly, Dr. Shaw and Mr. Bush, of Bristol, have reported recently a most interesting case in which they remained in doubt as to the true nature of the disease, but which not improbably falls into the same category of spina bifida occulta.

The history given by this patient was that, eleven years before being seen, he sustained a wrench of the lower part of the back, from which he dated his illness, although he also stated that for two or three years before the accident he had felt slight dull pains in the popliteal spaces and on the outer sides of the legs and heels. His condition, when seen by Dr. Shaw, was typically that of a pressure lesion of the cauda equina. The lower limbs were weak, especially as regards the hamstring muscles and those of the leg and foot. A perforating ulcer was situated on the ball of the right great toe. Anæsthesia was of the cauda equina type, but presented the peculiarity that the penis and scrotum were analgesic, but not anæsthetic. The muscles except the quadriceps extensor and sartorius showed the electrical reaction of degeneration. Further, there was severe pain in the backs of the thighs and legs, all the symptoms being progressive. The fourth or fifth lumbar spine appeared to be prominent, and at this point there was tenderness on percussion or on the application of heat. An operation performed by Mr. Bush with considerable benefit revealed "a swelling in the middle line, over the lower lumbar spine, which was freely incised, when a rounded cavity covered in with a thin shell of bone came into view. The fifth lumbar spine and lamina had disappeared, and the cavity, which proved to be the dilated spinal canal, contained a solid mass, which was removed. The cauda could not be clearly defined as it was pressed forwards." Microscopically the mass from the spinal canal showed a well-organised blood clot with some fibrous tissue, but no other distinctive structure. My suggestion is that in this case also there had not improbably been either a spina bifida occulta or a true obsolete spina bifida, which had sustained some injury giving rise to hemorrhage at the time of the accident to which the patient ascribed his symptoms.

THE CROONIAN LECTURES

ON

A NEW DEPARTURE IN DIABETES.

Delivered before the Royal College of Physicians of London.

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[Special Abstract Report.]

LECTURE II.

THE GLUCOSIDE CONSTITUTION OF PROTEID MATTER.

AFTER a few preliminary observations, Dr. Pavy observed that the molecule of unchanged starch was extremely complex, and that in the process of hydration this complexity was greatly diminished. This was sufficiently indicated by the fact that while the molecular weight of starch was represented by figures between 20,000 and 30,000, that of maltose was 342, and of glucose 180. In the dehydration of sugar into starch in the vegetable kingdom there was not only a subtraction of the elements of water, but a molecular synthesis, leading to the formation of the very complex molecule of the amylose. In the animal kingdom a parallel process occurred with proteid matter. In either case there was, in the process of growth and maintenance of the individual organism, first of all a breaking up by ferment action and chemical action, and then a synthesis by protoplasmic action.

In the first lecture it had been pointed out that from the proteid molecule could be cleaved off a carbo-hydrate molecule. This was equivalent to affirming the glucoside constitution of proteid matter. The group of glucosides comprised bodies of very variable composition; in some, of which salicin might be taken as an example, only the three elements—carbon, hydrogen, and oxygen—were present. In others—of which amygdalin was an instance—nitrogen existed in addition; while in others again, of which myronic acid, obtained from black mustard, was an example, sulphur was also a constituent of the molecule. Another step in the direction of increasing complexity carried us to a body standing in close proximity to the proteids—namely, mucin—