CASE OF TUBERCULAR TUMOUR OF THE SPINAL CORD IN A CHILD TWO YEARS OLD.

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THE following case is of interest not only as the record of a somewhat rare condition, namely, tubercular tumour of the cord, but also on account of some of the other morbid conditions which were found in the cord and medulla on microscopic examination.

Wm. D., aged two years, was first seen by me as an out-patient at the Children's Hospital on August 19, 1901. He was subsequently admitted into the wards under the care of Dr. Middleton, who has most kindly placed at my disposal his notes of the case, and to whom I am indebted for permission to publish it.

The history of the patient was briefly as follows. When six months old he had whooping cough, but excepting that he seemed to have been fairly well till he developed an attack of "pneumonia" at eleven months. On recovering from this he was "very weak," and made but little attempt to use his legs, though previous to the illness he could stand when holding on to a chair. Then, two months before admission, he had a second attack of "pneumonia," and on recovery his right arm was found quite powerless. Subsequent to this some paresis was also noted in the left arm.

At the time of admission to hospital he was a pale and rather ill-nourished child. The pupils were equal and reacted to light. There was an internal strabismus of the right eye. The head was turned towards the left shoulder, and some rigidity was to be made out in the muscles of the left side of the neck. The right arm was completely paralysed and the muscles quite flaccid, but there was no apparent wasting of the muscle fibres: no tendon

reflexes were obtained. The left arm still retained some voluntary movements, but there was a certain amount of rigidity, especially in the upper arm muscles. The arm was kept in the position of pronation, with the fingers closed on the palm of the hand, and on attempting supination the child evidently experienced a good deal of pain.

The right leg was extended, and there was a slight degree of rigidity in its muscles. No voluntary movement was to be noted. There was some slight movement to be seen in the left leg, but little or no rigidity. Both knee-jerks were exaggerated, the right more so than the left. Ankle-clonus was easily obtained in both. The plantar reflex was present in the left but absent in the right. The superficial reflexes all over the body were defective, and sensation as tested with a needle was evidently very defective, especially in the arms, but also in the trunk and legs.

There was no spinal deformity, and the organs of the chest and abdomen seemed quite normal.

The child's condition remained much as above described till about the middle of September, when unmistakable signs of meningitis developed. From this date onwards unconsciousness was more or less complete, and death supervened on September 29th. The temperature throughout ranged mostly between 100° and 101°, on very few occasions reaching 102°.

The *post-mortem* examination was made by Dr. A. R. Ferguson, to whom I am indebted for the following report, and by whose courtesy I have been permitted to investigate the microscopic appearances of the nervous system.

“*Head*.—The dura mater is slightly increased in thickness; it has no intimate connection with the bones of calvarium. The fontanelles are open. The surface of the brain is dry and glazed. There is considerable distension of the lateral ventricles with limpid fluid, and the entire ventricular system is proportionately dilated, the fifth ventricle also showing dilatation.

“There is a typical tubercular meningitis, distributed chiefly at the base and along the sylvian fissures. Tubercles are exceedingly numerous. There are no tubercular masses in any part of the brain.

“*Spinal Cord*.—The cervical enlargement is distinctly more voluminous than normal, and soft in consistency. The remainder of the cord presents no definite change on naked

eye inspection. There is practically no fluid in the spinal meninges (*N.B.*—Lumbar puncture had been performed during life), and they are apparently free from inflammatory exudation.

“*Chest.*—The *heart* is atrophied. There is no degenerative change in the myocardium visible to the naked eye, and no lesion of the valves.

“The *right lung* is intimately adherent at the apex, and its removal is only effected by tearing, in which a tubercular cavity at the apex is opened into. This is subdivided into a number of intercommunicating loculi (none large), and some of which at least are of bronchiectatic origin. There are scattered tubercles throughout the remainder of the lung. The bronchial glands are enlarged and caseous. The *left lung* shows a lesser tubercular infection.

“The *spleen, kidneys and liver* are free from tubercles so far as this can be affirmed by naked eye scrutiny. The kidneys are anæmic and the liver fatty. The mucous membrane of the *stomach* is catarrhal. The *intestine* contains numerous tubercular ulcers of recent appearance. These are chiefly met with in the lower part of the ileum. The mesenteric glands are enlarged and partially caseous.”

The pons, medulla, and cord were placed for twenty-four hours in 10 per cent. formol. After that certain segments were transferred to Müller's fluid, the rest being retained in formol solution so as to fix them for Nissl's stain. Sections from the former segments were stained by Marchi's and by Weigert's methods, and those from the other segments by theonin and by hæmatoxylin and eosin.

On more detailed examination of the cord the swelling in the cervical region mentioned in the above report was seen to occupy five segments (about one and a half inches in length), beginning at the second pair cervical nerves and ending at the seventh cervical. On transverse section the cause of this enlargement was found to be a tubercular nodule, somewhat oval in shape, about three-quarters of an inch in length, and occupying the centre of the cord, with but a narrow rim of cord tissue surrounding it. Its upper end occupied part of segment three, and the nodule extended

through the whole of segment four and the greater part of segment five. Its greatest breadth was in segment four, where it measured transversely half an inch. The general outlines of the tumour in transverse section are shown in the diagrams. All the figures from the cord are drawn by the aid of the camera lucida, and they represent more or less accurately the proportion in size of one transverse section to another and to the various elements which each contains. The first indication of the tumour is in figure C_2 , which is from the lower end of the second cervical segment, or possibly from the upper part of the third cervical. This section lies adjacent to the upper end of the tumour, and the deformity of the gray matter on the right side of the section was doubtless due to pressure of the tumour, the upper end of which occupied, most probably, the foramen indicated in that part of the section. The figures C_3 , C_3' , C_4 , and C_5 all show succeeding levels of the tumour. As far as can be made out, the growth has commenced in the right posterior horn, which has to a large extent been obliterated. The right anterior horn has also almost entirely been destroyed. It is quite lost in C_4 , but it is represented in C_3' and C_5 by a few ganglion cells lying immediately along the right margin of the tumour. The left anterior and posterior horns are uninvolved throughout.

As to the ganglion cells in this gray matter, it is astonishing how little alteration they really have undergone. In sections at the upper end of the tumour (C_3) the majority of the cells in the right anterior horn certainly show chromatolysis, *i.e.*, fragmentation of the Nissl-granules; but the nucleus in most still remains central and the cells still retain their processes. Even the ganglion cells at the margin of the tumour, and which are being surrounded by inflammatory cells, show but little change beyond some fragmentation of the granules. In the left anterior horn there is also a fair proportion of cells showing commencing chromatolysis, but not so many as in the right horn. At levels C_3' and C_5 the ganglion cells of this left anterior horn show practically the same appearances as in C_3 ; and a count of the number of cells in this left horn at these different levels confirms the impression that

very few cells have disappeared as a result of the chromatolytic process. Only four or five cells are to be seen in the remnants of the right anterior horn in C_3' and C_5 , but most of these, though undergoing degenerative change, still retain their nucleus.

The tumour itself is certainly tubercular. Its centre has undergone caseation, and is surrounded by a dense but somewhat narrow ring of cell formation. The most dense parts of the ring surround blood-vessels, and here round cells are most abundant. In other parts of the "ring" the round cells are mixed up with spindle-shaped cells and epithelioid cells. Here and there, round the margin of the tumour, groups of cells are seen extending out a short distance into the gray and white matter of the cord, and inwards into the caseating centre.

The white matter surrounding the tumour is best studied in the Marchi sections (C_4), but even here it is difficult to be quite certain of its identity. It is clear, however, that the pyramidal fibres remain intact, for no degeneration is found in the motor tracts at the eighth cervical, or in any of the other Marchi sections lower down the cord. Judging, however, from the section C_4 , one would have looked for degeneration in the right pyramidal tract, which at this level must be greatly flattened out, and in close association with many degenerate fibres from other tracts. Both direct cerebellar tracts show degeneration, especially the right. Only the left posterior column remains, and its fibres have also undergone degeneration. The right posterior column cannot be recognised, and it doubtless has been displaced by the tumour. The left antero-lateral tracts contain some scattered degenerate fibres, but the right antero-lateral tracts are not clearly to be made out.

The degenerated fibres above and below the tumour are indicated in the diagrams. From these it will be seen that there is a marked degeneration at the eighth cervical segment (C_8) in the posterior columns, being more intense in the postero-external than in the postero-internal tracts. It is to be noted, too, that in the right postero-lateral

tract there is a wedge-shaped area giving no reaction with the Marchi stain, but showing with Weigert's method a degeneration of older standing than is to be seen in the other fibres at this level. Both direct cerebellar tracts also contain degenerate fibres, and there are some few degenerate fibres scattered through the antero-lateral tracts.

Passing down the cord (T_1 , L_1 , L_4 , and S_1) the sections are seen to be almost free from degenerate fibres, and where these do exist they are not closely grouped into any definite tract. In most of the sections there are a certain number of blackened fibres round the margin of the cord; the rest are mostly scattered through the posterior columns.

Above the tumour (C_2 and C_1) the degeneration of the posterior columns is still marked, being most intense in the postero-lateral tracts, and still showing the wedge of more advanced degeneration on the right side, the same as seen in C_8 . In the two sections of the medulla the degenerate fibres are found surrounding the nucleus gracilis and nucleus cuneatus, and they can be traced passing forwards in the internal arcuate fibres and upwards in the fillet of the upper medulla. In the section of the pons (level of seventh nerve), the degenerate fibres of the fillet are not very certainly made out. Neither are the degenerate fibres of the direct cerebellar tract to be seen at this level, though they are well shown in the sections of the medulla.

As regards the ganglion cells of the gray matter above and below the tumour, there is not very much to say. At the sixth cervical segment (C_6) of the ganglion cells in the anterior horn, those in the antero-lateral groups are fairly healthy. But in the left postero-lateral group about 50 per cent. are seen to be in different stages of a commencing chromatolysis. This seems to be a central chromatolysis, *i.e.*, it commences round the nucleus and progresses towards the periphery of the cell. The right postero-lateral group shows a smaller proportion of these degenerate cells, but on counting the number of cells in this group there are found to be only about half as many cells as in the left postero-lateral group; the number in this left postero-lateral group may be taken as normal.

On passing into the seventh cervical segment the degenerative changes are much more marked, for throughout the whole of this segment (sections were examined at three different levels) scarce a single normal cell is to be seen. The vast majority of cells have a homogeneous plasma without any granules whatever. A few have some peripheral granulation. Most have a peripheral nucleus; but in a considerable proportion the nucleus has entirely disappeared. The different groups of cells seem to be equally affected, and on a count being made practically no diminution in the number of cells can be found. All the sections in this seventh segment show a great invasion of inflammatory cells. This is specially marked, passing in with the posterior roots, and throughout the gray matter.

Throughout the whole of the dorsal region of the cord (eight levels were examined) the ganglion cells were found quite healthy, and this applies also to the cells of Clarke's column. The same may likewise be said of the lumbar and sacral regions.

Sections were also examined from the upper part of the first cervical segment, and here the appearances were very similar to those described in the sixth cervical, *i.e.*, about half the ganglion cells show an early degeneration.

The only two motor nuclei which appear in the Nissl sections of the brain are the seventh and twelfth, and the ganglion cells in both of these are practically normal.

As to the meningitis referred to in the *post-mortem* report, this is well seen in the sections stained with hæmatoxylin and eosin. It is most intense in the pons and medulla, for here the pia is densely infiltrated with cells, the infiltration being most marked round the vessels. The majority of the cells are round cells (leucocytes), but there are also a considerable number of epithelioid and spindle-shaped cells. Also, and especially in groups, there are some larger, round cells with deep-staining central nucleus, which have been called "contractile cells." A few giant cells are likewise made out. There is no caseation in any of the nodule-like collections of cells. A certain amount of infiltration of these inflammatory cells into the substance of the pons and

medulla is also to be seen. This is most marked in the neighbourhood of the fourth ventricle, but there is also a slight increase of the connective tissue cell element throughout the whole section, though except at certain parts of the periphery it is by no means well marked. This infiltration should doubtless be regarded as an exudation from the vessels rather than an increase of the neuroglia cells, but that there is no increase of these cells it is difficult to be certain.

The pial investment of the cord shows the same cellular infiltration as that of the medulla, though it lessens much in intensity in the dorsal, lumbar and sacral regions. It always seems to be most intense round the posterior roots, and at this point, in some of the sections, there is quite an invasion of inflammatory cells into the substance of the cord. This is very marked in the seventh cervical segment, where the infiltration into the posterior columns and gray matter of the cord is most striking: it is doubtless the cause of the degeneration of the ganglion cells already described as being present at this level. This same infiltration, but to a much less extent, is seen in the sixth cervical segment, and to a still less degree in the dorsal, lumbar and sacral regions. In the antero-lateral tracts at these last-mentioned levels there is practically no increase of the connective tissue elements.

The central canal throughout the whole extent of the cord shows a slight amount of dilatation.

It has just been said that in the section of the cord the meningitis seemed most intense round the posterior roots. It is also to be noted that in all the sections from the cervical region the posterior roots, as they lie within the cord, give a well-marked reaction with Marchi's stain. But in striking contrast is the appearance of the roots before entering, *i.e.*, as they lie outside the cord, for in very few of the sections do these roots show any blackened fibres whatever. For example, in C_1 and C_3 the posterior root external to the cord gives no degenerative reaction, but the moment the boundary of the cord is crossed the degeneration of the fibres becomes very marked. In C_2 and C_4 the right posterior root gives a slight reaction where it is outside, but the reaction is nothing

like so intense as when the fibres have entered the cord. In the dorsal, lumbar, and sacral regions the root within the cord gives a slight reaction, and this only at certain levels; but external to the cord there is practically no blackening of the fibres whatever.

Of peripheral nerves, the right vagus, the right median and right posterior tibial were all examined, but none gave any reaction with the Marchi stain. It is to be noted, however, that these same nerves, when stained with hæmatoxylin, showed an undoubted increase of the internodal nuclei, which, I take it, indicates an early degenerative process going on in these nerve fibres, though the myelin has not yet become fatty.

That, then, is the case as it presented itself to us; and in considering it in the light of the above report it is evident that there are two quite separate morbid conditions to be considered, namely, the tubercular tumour and the tubercular meningitis. Of the tumour little requires to be said beyond mentioning that such tubercular nodules of the cord, unassociated with tubercular nodules in other parts of the nervous system, are very rare, or, at least, very few such cases have been put on record.

As to the degenerations above and below the tumour, these must be looked on as due rather to the meningitis than to the tumour itself. The proof of this lies in the fact that the ascending degeneration is quite as marked in the eighth cervical as in the second cervical segment; also it may be added that there is no degeneration of the pyramidal tracts below the level of the tumour.

The meningitis may, then, be taken as the chief cause of the ascending degenerations; and it would seem to produce its effect in two ways: first, by acting directly on the ascending fibres themselves, and, second, indirectly by its effect on the posterior roots. That the degeneration in the posterior columns is due mainly to involvement of the posterior roots is evident on looking at sections C_8 , C_2 , and C_1 . In these the fibres in the postero-lateral tract (root zone) are chiefly affected, and their distribution is much the same as that which has been produced experimentally by section

of a posterior root at this level. But the degenerate fibres in the postero-median tract (column of Goll) in, for example, C₈, cannot be explained in this way; for we know that none of the fibres in the column of Goll, in the lower cervical segments, enter the cord by roots higher than the mid-dorsal region, and that they probably enter by roots a good deal lower down. Now, in the sections below the mid-dorsal level in our case there is no sufficiently marked degeneration of posterior roots or root zones to give such a well-marked degeneration as is found in the postero-median tract at C₈; so that I am disposed to attribute the most of the degeneration in this tract, at least in the lower cervical segments, to the direct action of the meningitis, either from the pressure of its exudation or from the poisonous action of the toxins which this exudation contains. The degeneration of the direct cerebellar tracts must also be explained in this way, for they show no degeneration in the dorsal region, neither is there evidence of involvement of the cells in the columns of Clarke. And if the direct cerebellar tracts may be affected by the meningeal exudation, there seems no reason why the columns of Goll, at least their most superficial parts, should not be affected also.

The degeneration of the posterior roots is probably also due to the direct action of the exudation, which would seem to penetrate more readily to the part of the root within the cord than to the part which lies without, and which is still invested with its sheath. This will perhaps explain why the degeneration is so much more intense in the part of the root within than in that lying outside of the cord.

The "comma" tract of Schultze shows no evidence of degeneration in any of the sections from the upper dorsal region. This is a matter for comment, for in the fourth cervical segment there seems to be a total loss of the right posterior column, and as a result one would look for a descending degeneration in the "comma" tract on this right side.

Of the degenerate fibres which pass up in the posterior columns to the medulla, we have seen that this degeneration

does not cease in the nucleus gracilis and nucleus cuneatus, but that blackened fibres are seen passing forwards in the internal arcuate fibres and upwards in the fillet. It may be that some of these fibres are continued up from the cord, as has been noted in some other published cases¹; but it is more likely that the meningitis in our case has injured the cells of these two posterior nuclei or the fibres which originate from them. The degenerate fibres of the upper medulla should therefore be considered as having no direct connection with the fibres from the posterior roots, but as belonging to quite a separate neurone system, whose fibres commence in the ganglion cells of the nucleus gracilis and nucleus cuneatus.

¹ Purves Stewart, *BRAIN*, Summer number, 1901; also, Barker, "The Nervous System," London, 1900, page 461.

R.

L.

N. VII.

Pons.

Upper Medulla.

Medulla.

R.

L.

C₁ (Marchi).

X—This area shows degeneration with Weigert's stain.

R.

C₂ (Nissl). C₂ (Marchi).

X—This area shows degeneration with Weigert's stain.

C₂' (Nissl). C₄ (Marchi).

R.

L.

C₂ (Nissl). C₃ (Nissl). C₇ (Nissl). C₈ (Marchi).

X—This area shows degeneration with Weigert's stain.

R.

L.

T₁ (Marchi). L₁ (Marchi). L₄ (Marchi). S₁ (Marchi).