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THE DIAGNOSIS OF
LESIONS OF THE LUMBAR CORD,
CAUDA EQUINA, AND CONUS MEDULLARIS.*

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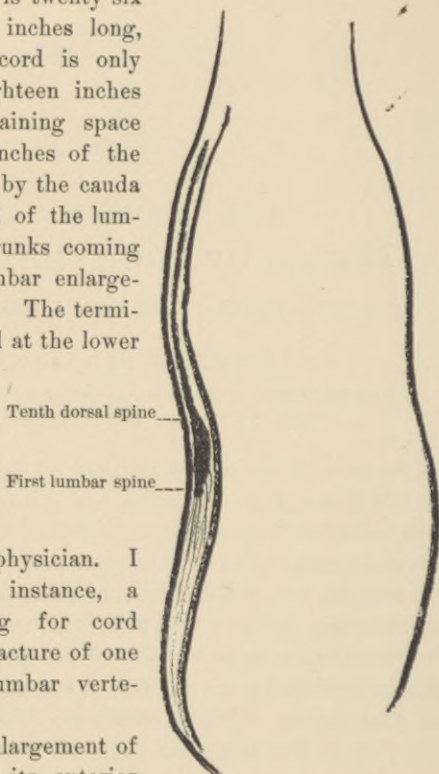
As an evidence of the progress of neurological science of late years, there is perhaps nothing more interesting than the unraveling of the mysteries of the tracts and centers and nerve trunks of the lower part of the spinal cord. We are now in a position to make very accurate diagnoses of the nature and position of lesions in the lower part of the spinal canal from a study of the peculiar distribution of anæsthesias, the extent and character of paralyses, and the disturbances of various reflexes. Then, too, lesions in this part of the organism, such as caries, spinal injuries, hæmorrhages, and neoplasms, are not so rare but that a brief exposition of the points of differential diagnosis should be of service to every physician.

The lumbar enlargement of the cord lies in the spinal

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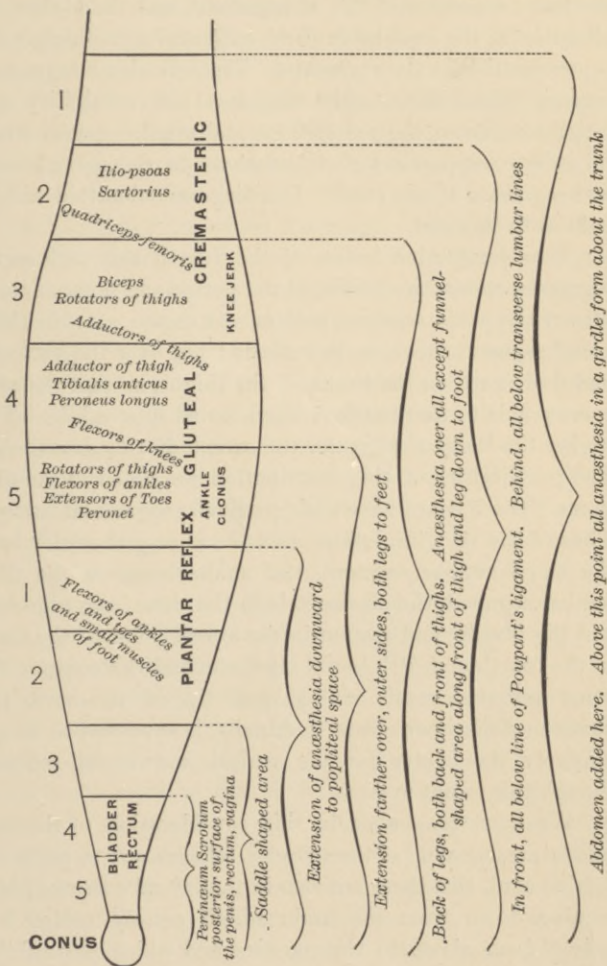
canal opposite to the space between the lower portions of the tips of the tenth dorsal and first lumbar spines. Thus the spinal canal is twenty six to twenty-eight inches long, and the spinal cord is only seventeen or eighteen inches long. The remaining space of nine or ten inches of the canal is occupied by the cauda equina, composed of the lumbo-sacral nerve trunks coming off from the lumbar enlargement of the cord. The termination of the cord at the lower border of the first lumbar vertebra is not always kept sufficiently distinct in the mind of the student or physician. I have seen, for instance, a physician seeking for cord symptoms in a fracture of one of the lower lumbar vertebræ.

The lumbar enlargement of the cord has in its anterior horns the trophic centers for all of the muscles of the lower extremities. Into it pass all the sensory fibers from the lower extremities, genitals, rectum, and nates. In it are the reflex centers for such important reflexes as the knee-jerk, ankle-clonus, cremasteric, plantar, and gluteal reflexes. And here, too, are the centers for the sphincters



of the bladder and rectum, and for erection, menstruation, and parturition.

These various organs and functions are represented



serially in the segments which constitute the lumbar enlargement, five lumbar and five sacral segments. The centers for the lowest muscles of the lower extremities are in the lower segments of this enlargement, and the higher the situation of the muscles in these extremities the higher the representation in the segments. There is also a segmental sensory distribution, only the areas of sensibility run lengthwise down the extremities, and require special study in order to appreciate their relations to the nerve trunks and segments of the cord. The diagram submitted will be helpful to this end.

Thus destructive lesion of the fourth and fifth sacral segments causes anæsthesia of the perinæum, posterior surface of the penis, scrotum, rectum, and vagina. At the third sacral segment this area is extended out over the buttocks and downward on the backs of the thighs, so that the area corresponds to that touched when seated in a saddle. The higher the lesion the greater the extent of this anæsthesia. The peculiarities of this distribution are noted in the diagram. The reflexes have their particular segmental centers. Thus of the very important ones, the knee-jerk center is in the third lumbar segment, the ankle-clonus in the fifth lumbar segment, the cremasteric in the three upper lumbar, and the bladder and rectum in the lowest point of the cord, in the fourth and fifth sacral segments and the conus. By some authorities this club-shaped tip of the cord, the conus medullaris or conus terminalis, is supposed to be exclusively the center for the vesical and rectal reflexes, though this is not proved.

We must remember, in this consideration of the segmental arrangement of the muscles, reflexes, and so on, in the lumbar cord, that there are also in the lateral columns fibers coming down from the brain which convey motor impulses from above to the muscles and which also inhibit

the reflexes. Thus a lesion in the second lumbar segment might exaggerate the knee-jerk and cause ankle clonus, because of the inhibitory fibers to these centers being affected. On the other hand, a lesion in the third lumbar segment may give us the very singular phenomenon of lost knee-jerks in conjunction with ankle clonus.

Now, the cauda equina is composed chiefly of the great nerve trunks arising from this lumbar enlargement, one pair from each segment, and hence each pair of nerves represents the motor, trophic, sensory, and reflex functions of the segment from which it springs. Any lesion of them must necessarily cause much the same effects as would arise from lesions of the segments from which they come. Thus lesions affecting the sacral nerve roots produce the same anæsthetic areas as do lesions of the sacral part of the cord, together with paralysis of the bladder and rectum. A lack of symmetry on the two sides in the distribution of the paralyses and the anæsthetic areas would be, however, presumptive of a cauda rather than a cord lesion. An exceedingly slow and irregular development of the symptoms would also suggest a cauda lesion. But it is not always easy to distinguish cauda from spinal-cord lesions, and the fact must be borne in mind that often both the cauda and the lower part of the cord are involved together in the pathological process.

It has been demonstrated that pressure on the cauda equina affects to a greater degree the nerves in the middle of the cauda than those near the surface (Thorburn). The lower nerve roots of the cauda are nearer the middle line than the nerves which pass out above them; and when pressure is brought to bear upon the cauda, the nerves which pass out at the lower level are more seriously affected than those emerging above them.

In lesions such as hæmorrhage or compression, where im-

provement may take place, the upper roots are apt to show signs of a change for the better soonest, and may indeed recover completely, while the lower ones remain as before.

Pressure upon the nerves of the cauda is often sufficient to produce widespread paralysis when sensation is but slightly affected (Starr). This is often of value in a differential diagnosis, since lesions of the same magnitude in the lumbar enlargement would produce only a moderate amount of paralysis, depending upon the segment or segments involved.

In traumatic conditions the external evidence of fracture below the first lumbar vertebra, affecting the lumbar or sacral portions of the spinal column, would be an important indication of involvement of the cauda equina.

Pain and tenderness over the lumbo-sacral regions have been noted in some of the cases of lesions of the cauda equina, such as neoplasms. The pain is nearly always chiefly sacral.

In cauda lesions the sciatic and pudic and sometimes the anterior crural and obturator nerves are particularly apt to suffer. Whether the degenerative reaction in the muscles supplied by the affected nerves will be present depends naturally upon the amount of damage done to them, which is variable.

As to the reflexes, the knee-jerks will be absent if the nerves to the anterior thigh muscles are affected. In no case of purely caudal lesion will they be exaggerated. The plantar reflexes are usually absent. The extent of the lesion in the cauda will determine to what degree the sphincters are disturbed. Disorder of the mechanism governing the sphincters of the bladder and rectum will depend upon whether their particular nerves are involved and to what degree. Urinary retention with overflow incontinence is not very frequent in cauda lesion, and when it does exist

may be recovered from as pressure diminishes. The presence of complete paralysis of the bladder and rectum is rather suggestive of coincident lesion of the lower tip of the cord.

Bedsore, and sometimes perforating ulcers, occur in a certain number of cases of cauda lesion.

In some instances it may be necessary to differentiate peripheral nerve lesions, such as multiple neuritis and disorders of the lumbar and sacral plexuses. Ordinary multiple neuritis presents no difficulty, but a bilateral lumbo-sacral neuritis may offer obstacles in the way of diagnosis for some time until absolutely characteristic symptoms have appeared. In other lumbo-sacral plexus lesions a bilateral manifestation of symptoms should form a diagnosis of cauda disorder, though in some very rare instances the cauda lesion may involve but one side and thus give rise to confusion.

Occasionally a lesion of the cauda (tumor) may for a time simulate locomotor ataxia by presenting some of the symptoms common to both—viz., loss of knee jerks, disorder of the bladder sphincter, sharp pains radiating down the legs, and peculiarity of gait. But there will be no ataxia, and papillary symptoms will be wanting, while atrophies and anæsthesias are almost certain to develop in the course of time and thus demonstrate the presence of a cauda lesion.

The most common of all lesions affecting the cauda is fracture and dislocation of the lumbar spine, compressing or crushing the nerve roots, or both. Moderate dislocation of the vertebra may cause little damage, because of the large size of the canal and the small part of it occupied by the nerves. The symptoms will vary with the extent and degree of the injury. Hæmorrhage is another though infrequent lesion of the cauda equina. Much more common

than this are neoplasms. Among the tumors which have been described as developing in this part of the vertebral canal and affecting the cauda equina are sarcoma, fibrosarcoma, meningocele in spina bifida, gumma, cavernous angioma, and multiple neuromata.

The chief characteristics of tumor compression of the cauda equina are slow and progressive development of the atrophic paralyses, reflex disorders and anæsthesias peculiar to the region, and intense and increasing sacral pain of a radiating character, and sacral tenderness. Sometimes retrogression may take place, or the growth be temporarily arrested.

As regards isolated lesions of the conus medullaris, it has become current in neurological literature to a certain extent that we have from such complete paralysis of the bladder and rectum. This would mean that the vesical and rectal reflex centers then were situated wholly in the conus. But, as far as I can learn from a careful search of the literature, this current idea is based upon two cases reported respectively by Oppenheim and Lochmann. Oppenheim (*Arch. f. Psych.*, xx, 1889, p. 298) has a paper Ueber eine sich auf den Conus Terminalis des Rückenmarks beschränkende traumatische Erkrankung; but, on reading his paper and the result of the autopsy, I find it is not at all a case of "traumatic disease limited to the conus terminalis," for he describes how the changes become less marked in the sacral portion of the cord, and still less so in the lumbar portion. Lochmann's case, too, is not wholly satisfactory in this respect.