Concussion of the spinal cord (railway spine) / by De Forest Willard and William G. Spiller.

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(RAILWAY SPINE).

BY

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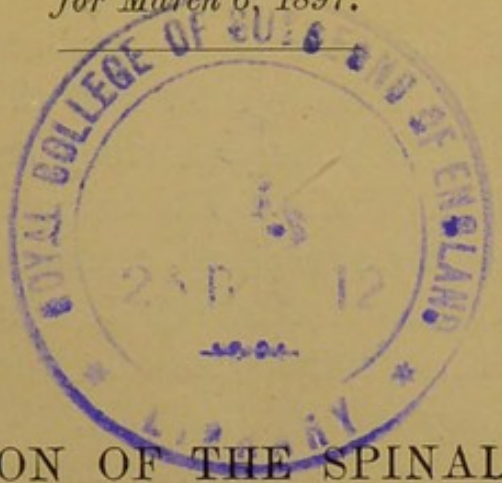

CONCUSSION OF THE SPINAL CORD

(RAILWAY SPINE).*

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Microscopic work from the William Pepper Clinical Laboratory.

The following case of fracture is interesting from a pathological standpoint rather than from a clinical. The accident occurred during the service of Dr. De Forest Willard at the Presbyterian Hospital. We are indebted to Dr. W. E. Hughes, pathologist to the hospital, for the material.

In consequence of a severe blow from a trolley car the spinal column was fractured at the eleventh thoracic vertebra. The lower limbs were completely paralyzed, and no involuntary movements were noticed. Sensation was entirely lost below Poupart's ligament, except on the front and outer part of the thighs, in the dis-

* Read before the Philadelphia Neurological Society, October, 1896.

tribution of the external cutaneous nerves. These nerves arise from the second and third lumbar roots (Gray), though in some cases they receive fibres from the first lumbar (Quain). The lesion in the spinal cord was located chiefly at the first, second, and third lumbar segments. It has been shown that it is necessary to cut at least three spinal roots in order to destroy the sensation in any area of the body. This fact may explain the preservation of sensation in the distribution of the external cutaneous nerves notwithstanding the location of the spinal lesion.

Inability to urinate and defecate was observed. On examination, the eleventh thoracic vertebra was found elevated and the twelfth depressed. By manipulation the prominence was reduced, but the depression remained. Death was chiefly due to exhaustion. At the autopsy a large amount of blood was found in the muscular and connective tissues at the seat of injury, the laminæ of the eleventh thoracic vertebra presented an irregular line of fracture, and hæmorrhage was noticed within the vertebral canal, but external to the dura. It is probable that most of this blood flowed into the canal in removing the posterior part of the vertebræ. There was no evidence of displacement of the vertebral bodies. The dura was intact, and after it had been opened no hæmorrhage was observed within. The cord, even at the seat of fracture, was quite firm and of normal shape, and presented exteriorly no distinct signs of softening. It was placed at once in Müller's fluid and transverse cuts were not made at this time, as the material was desired for microscopic study. There were no indications of injury from pressure upon the spinal cord exteriorly.

As the vertebral bodies were not removed, it could not be determined whether they were fractured or not; no evidences of this were noticed from examination *in situ*.

The accident occurred on a Monday, and the patient lived until the following Saturday.

From the picture given by Gowers * of the relations of the vertebral column to the cord, we would expect to find the lesion caused by dislocation of the eleventh upon the twelfth thoracic vertebra greatest in the first, second, and third lumbar segments. This was exactly the area injured.

The microscopic findings consist of displaced fibres in one portion of the cord, numerous hæmorrhages, altered blood pigment, masses of granular corpuscles, necrosed tissue, swollen axis cylinders, tumefied ganglion cells, and round-cell infiltration. The spinal roots contain a few swollen axis cylinders, and the medullary sheaths do not stain quite as deeply with hæmatoxylin as do those of normal fibres. The blood-vessels everywhere are much dilated.

The case reported recently by A. Westphal † has many features in common with the case which forms the subject of this paper. His patient fell from the second story to the pavement in a delirium of fever. After the accident the movements of the upper extremities were free and the lumbar portion of the spine was very sensitive to pressure, although no deformity was present. Complete flaccid paraplegia of the lower limbs, with absence of the knee-jerks, was observed.

* Gowers. *Diseases of the Nervous System* (English edition), vol. i, p. 163.

† Westphal. *Archiv für Psychiatrie*, xxviii, Heft 2, p. 554.

At the autopsy the bodies of the first and second lumbar vertebræ were found broken, and the vertebræ were dislocated, but nowhere, as in our case, was there pressure on the cord and its membranes. The muscular tissue at the seat of fracture was infiltrated with blood. The dura was intact, and there was no hæmorrhage within it. The form of the cord was well preserved. The greatest alteration was observed in the sacral region. When microscopical examination was made the ganglion cells were found altered, swollen, and rounded off; in some the nucleus was displaced, in others there was no nucleus or no nucleolus. There was rarefaction of the gray and white matter, and small hæmorrhages were found in the gray substance, especially about the central canal and in the white matter. In the sacral cord the normal outlines of gray and white matter were altered and could not be fully defined. In this case, as in our own, dislocation of the vertebræ occurred. This explains the displacement of fibres, but many of the other changes must be considered as the direct result of the concussion to the spinal cord, as Westphal himself says, in regard to his case. His patient lived seven days after the accident, ours survived the trauma five days.

Westphal states that most of the cases of traumatic myelitis known to him in the literature concern persons in whom death occurred immediately or else a long time after the accident, and are unfitted for the study of the early morbid changes. His case, therefore, and ours present such alterations as occur within a week. In a paper published by one of us * the changes which

* Spiller. *International Medical Magazine*, April, 1896.

occur after thirty-six hours were mentioned. These consist mainly of swelling of the axis cylinders.

The two regions of the spinal column which seem to be especially liable to fracture are the lower cervical and the lumbar. In the paper already referred to (Spiller, *loc. cit.*) a case of fracture in the former of these two regions was reported, and the hæmorrhage within the gray matter was described. In that case the anterior horns were most involved, in this one the left posterior horn in the eleventh and twelfth thoracic segments was destroyed.

Goldscheider and Flatua * have shown by injecting staining solutions into the thoracic region of the spinal cord of the living and dead animal that the fluid, if injected into the anterior horn, has a tendency to pass to the posterior horn and to ascend in this; if injected into the posterior horn it is not apt to enter the anterior. This may be explained by difference in the formation of the two parts. From these experiments we must expect to find extensive hæmorrhage in the posterior horns more frequent than in the anterior. Lamy † has noticed after the injection of inert powder into the vascular system of the spinal cord that the emboli are more apt to obstruct the branches of the anterior spinal system which nourishes the gray matter, and even when they invade the entire vascular system the lesions are greater in the gray matter. After the vessels have been obstructed red softening of the gray matter almost invariably occurs. A central cavity may result from the

* Goldscheider and Flatau. Abstract in the *Semaine médicale*, 1896, Nos. 23 and 25.

† Lamy. *Comptes rendus des séances de la Société de biologie*, July 25, 1896.

softening, and in a dog he actually found such a cavity after the expiration of three weeks, which "resembled greatly syringomyelia." Cicatricial tissue may replace the necrotic tissue and present the appearance of an old hæmorrhagic focus.

It is not our purpose to discuss the possibility of a traumatic origin of syringomyelia; that has already been done (*loc. cit.*).

Emboli always follow the most direct current of blood, and these experiments of Lamy would strengthen the view already held, that in the vascular system of the cord the flow of blood is greater and more direct in the distribution to the gray matter.

Pfeiffer * has published recently an interesting *résumé* of the views held in regard to spinal hæmorrhage.

Every neurologist has seen the cases of "railway spine" in which paraplegia or paraparesis, with increased reflexes, plays an important rôle, and usually such conditions are considered as functional. Frequently, however, the suspicion arises that after all we may be too quick in forming our diagnosis, and that possibly there is in some of these cases an organic change. The signs presented are often those which a lesion of the thoracic or cervical cord would give. Such a case is reported by Dercum.† The patient fell some thirty feet, and the resulting sensory and motor disturbances Dercum ascribes partly to actual physical injury, partly to traumatic neurasthenia. He speaks especially of the violence done to the muscles and the vertebræ after such serious accidents. Certainly the probability

* Pfeiffer. *Centralblatt für allgemeine Pathologie*, September, 1896.

† Dercum. *The Journal of Nervous and Mental Disease*, 1892.

of the existence of these organic changes must be apparent to every one. But have we not reason to think that the cord also suffers from such serious traumata? When the damage is so great that the vertebræ are fractured death frequently occurs, and we have an opportunity to study the spinal lesions. There are likewise cases of spinal hæmorrhage from trauma in which the vertebral column is not fractured, but these are rare. Usually in the milder forms of traumatism the patient lives on, more or less of a cripple, and the opportunity for microscopic study is not given. Such a case as the one published by Westphal, or as the one by Higier,* in which the symptoms indicated a lesion of the conus, while injury of the eleventh and twelfth thoracic vertebræ was observed therefore above the portion of the cord affected; or as the case we report, in which a large portion of the changes of the spinal marrow were probably not the result of fracture of the vertebra, but of the force which was great enough to cause the fracture—such cases must cause us to believe that even less severe trauma may produce cord lesions, though of less degree. If the paraplegia disappears after a period, it is quite possible that organic lesions, such as small hæmorrhages and areas of necrosis, may have been present. The recuperative power of the spinal cord is astonishing. Probably the most remarkable case in evidence of this is the one given by Charcot † with illustrations. The spinal cord in a case of Pott's disease at one part was only one third the normal size, or about the size of a goose quill, and was much sclerosed. Ascending and de-

* Higier. *Deutsche Zeitschrift für Nervenheilkunde*, vol. ix, 3–4.

† Charcot. *Œuvres complètes*, vol. ii, p. 103.

scending degeneration was well marked, but the functions, both sensory and motor, in the lower limbs had been perfect. The nerve fibres in this compressed portion were much below the normal number, and the gray substance was represented only by a single horn containing a few cells.

The gray matter is more apt to be involved by a hæmorrhage than the white. We refer to Lamy's experiments in this connection. Perhaps hæmorrhage may give the explanation of paresis and increased reflexes in some cases, acting by pressure on and not by destruction of the pyramidal fibres.

Indeed, experience has shown that not only the centre of the cord is more apt to suffer in trauma, but the centre of the cauda equina is subject to the same laws. Bruns * states that in tumor or trauma of the cauda, even at the upper part, the sacral plexus suffers more than the lumbar, and at first usually it alone is affected.

When in many of these mild cases of "railway spine" restoration of function occurs, it is probably frequently due to absorption of the hæmorrhages, relief of pressure, possibly vicarious action of the nerve fibres still sound, and restoration of function to paralyzed fibres.

Undoubtedly in many of these cases there is an element of neurasthenia, but it seems to us that sometimes too much is classed under neurasthenia. Obersteiner † has abstracted a case of spinal concussion published by

* Bruns. *Archiv für Psychiatrie*, xxviii, Heft 1, 1896.

† Obersteiner. *Wiener klinische Wochenschrift*, No. 30, 1896, p. 694, and *Medizinische Jahrbücher*, 1879.

Struppler. The patient died five weeks after a fall on the back. The lesions found in the cord were softening, diffuse degeneration almost throughout the entire length of the cord, and descending degeneration of the lateral pyramidal tract. Obersteiner remarks that in consequence of the teaching of Charcot concerning traumatic neurosis, the opinion held by himself and others regarding organic changes in some cases of spinal concussion has been forgotten. He, as far back as 1879, reported the microscopic examination of a case of spinal concussion.

Schmaus * has examined the cord from some of these cases of traumatic back at different periods after the occurrence of the accident, and has found very positive changes—such as areas of softening, accumulations of granular corpuscles, gliosis, cavity formation, primary degeneration of the pyramidal tracts, and, in one case, round-cell infiltration. In one case he speaks of infraction of the vertebral column, but the alterations he describes were also found when the vertebral column was uninjured, and these alterations are similar to the changes noted by us.

Schmaus produced concussion of the spine in animals. He found in these cases swollen axis cylinders and some destruction of the myelin. In one case he observed a focus of softening, in two cases gliosis in the gray matter, but rarely did he find hæmorrhage of any amount. The spinal vessels in all his experiments were congested. From these investigations it was positively determined that organic lesions may follow spinal con-

* Schmaus. *Münchener medicinische Wochenschrift*, 1890, p. 485' and Virchow's *Archiv*, 122, 1879.

cussion, and it was seen that the alterations produced experimentally represented earlier stages of those changes which he had found in man.

According to Schmaus, the important change is direct traumatic necrosis of the axis cylinders. He believes that if the trauma is not very severe the fibres are only functionally altered and may recover, and even if the trauma has been very violent the degeneration found at the examination does not represent all the fibres which have been deprived of function, for certain of these are in the earlier stages of the degenerative process. Bikeles * also has found destruction of the myelin sheaths after concussion of the brain in animals.

While we are not treating of commotio cerebri, we may, nevertheless, mention that Koch and Filehne, Witkowski, and Polis have shown that cerebral concussion may exist without visible organic changes. On the other hand, Duret, Bright, Rokitansky, Nélaton, Beck, etc. (quoted by Michél †), have found numerous capillary hæmorrhages in the brain, and have attributed the symptoms observed to these. It is quite possible that some of the cases in which organic lesions were absent were not studied by the finer methods of microscopic technique, as Michél suggests. This author also calls attention to the fact that Bollinger first showed that the signs of commotio cerebri may not develop for some time after the trauma. The trauma causes necrosis and alteration of the vessels, and in consequence of these changes late hæmorrhages occur.

* Bikeles. *Arbeiten aus dem Institut für Anatomie und Physiologie*, Obersteiner, Heft 111.

† Michél. *Wiener klinische Wochenschrift*, No. 35, 1896.

Interesting in this connection is the case reported by Hirschl.* Dementia and hemiatrophy of the tongue developed in consequence of trauma. Both conditions were supposed to be due to minute hæmorrhages. The statement that the hemiatrophy of the tongue was the result of organic changes will hardly be disputed.

* Hirschl. *Wiener klinische Wochenschrift*, No. 26, 1896.

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