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II. SPINAL LESIONS REGARDED FROM THEIR PATHOLOGICAL ASPECT—PATHOLOGICAL DIAGNOSIS.

I. AFFECTIONS OF THE SPINAL CORD DUE TO DISEASES OF THE BLOOD-VESSELS.

A. Diseases of the Arteries of the Spinal Cord and their Consequences.

The vertebral arteries which arise from the subclavian, and which unite to form the single basilar artery, give off, after having entered the skull, an anterior spinal and a posterior spinal artery by which the spinal cord is supplied with blood. The anterior spinal arteries of both sides unite to form a vessel which runs along the spinal cord in the anterior spinal fissure, while the posterior spinal arteries anastomose freely with each other without, however, completely uniting; the horizontal branches run along the septa. White and gray matter are nourished in the same way, but the capillary network of the latter is much denser than that of the white substance.

The venous blood is collected into two fairly large veins, which are called the central veins of the spinal cord. They anastomose freely among themselves, and are connected with the anterior and posterior spinal veins. From them the venous blood passes into the vertebrals, which empty into the innominate or the subclavian vein. About the diseases of the spinal veins up to the present nothing is known.

1. Spinal Hæmorrhage—Hæmorrhagia (or Apoplexia) Medullæ Spinalis—Hæmatomyelia.

While, as we have shown above, a primary hæmorrhage from the cerebral vessels is one of the most common causes

of lesions of the brain, spontaneous hæmorrhages from the spinal arteries are exceedingly rare, and indeed it seems hardly possible that a hæmorrhage could take place into the substance of the cord, so firmly held together as it is by the tough pia mater, without the previous existence of alterations in its consistence; besides, the anatomical conditions of the arteries are such that the blood pressure is decidedly lowered before the blood wave reaches the spinal cord; furthermore—and this is perhaps the most important reason for the rare occurrence of hæmorrhage into the cord—miliary aneurisms, which in the brain are the most frequent source of hæmorrhage, are never found here. For these reasons the existence of primary spontaneous spinal hæmorrhages has been absolutely denied, and it has been assumed that in every case changes in the consistence of the cord substance must have preceded. We fully agree with those who believe in their extreme rarity, but, nevertheless, we are of the opinion that under certain conditions primary hæmorrhages actually do occur. Such conditions are: (1) in old persons the coexistence of cerebral hæmorrhages in consequence of arterial disease; (2) the presence of such ætiological factors as excessive muscular exertion (heavy lifting, cutting wood, etc.); (3) the sudden and violent suppression of hæmorrhages in other places (the menses, hæmorrhoids, etc.); (4) the exposure to a sudden marked diminution of atmospheric pressure, as happens to those who follow certain occupations, as, for instance, workers in compressed air in building bridges or winning amber (cf. Hirt, *Gewerbekrankheiten im Handbuch der spec. Pathologie und Therapie*, vol. i, third edition, reprint, pp. 83 *et seq.*).

The pathological condition is either one of capillary hæmorrhages or of a hæmorrhagic infiltration in which the escaped blood extends between the nerve fibres along the course of the vessels, or finally we have hæmorrhagic foci, in which the blood coming from the vessels in larger quantities presses the nerve tissue apart and forms a sort of cavity. The focus usually extends in the longitudinal direction of the cord. Hæmorrhage may occur at any level of the spinal cord and in any portion of the cross-section, and may produce the same changes in its substance as cerebral hæmorrhage produces in the brain—changes with which we have become familiar in a previous chapter.

Clinically, spinal apoplexy is characterized by paralysis with a sudden onset, sometimes attacking the patient without

any premonition and while he is apparently in the best of health; he suddenly sinks to the ground without losing consciousness, and is deprived of the use of his limbs; occasionally prodromata, such as tearing pains or formication in the limbs, may precede for hours or days. The extent and the degree of the paralysis depend entirely on the seat of the hæmorrhage; it may be confined to one half of the body, or to both legs or to both arms, or it may take in all four extremities simultaneously. It develops extremely rapidly, and reaches its fullest extent within twenty-four hours. If this is not the case it is not a spinal hæmorrhage with which we are dealing. Pains and rigidity of the back and clonic muscular twitchings are equally constant, as are the bladder symptoms, which are probably never absent in hæmatomyelia. With regard to sensation and the reflexes no general rule can be given, yet an increase of the reflexes immediately after the catastrophe is not exactly rare. Death may occur within a few hours, an event which is especially likely to take place if the hæmorrhage is situated high up. In other cases the patient lives for days and weeks, and dies from the effects of bed-sores, of a cystitis, etc. Finally, at least relative recovery is not excluded; the patient may either get over the effects of the lesion, or he may be left with motor or sensory disturbances of the most varied kinds. The differential diagnosis between hæmatomyelia and hæmatorrhachis (meningeal apoplexy) has been discussed above. For the treatment we may try the application of ice to the spinal column and the internal administration of ergotine. The success of these measures is always very doubtful, and a careful attention to the nutrition and the cleanliness of the patient should in all cases be considered the thing of most importance.

2. *Embolism and Thrombosis of the Spinal Arteries and Myelomalacia.*

Embolism of the spinal cord, the development of which has been studied experimentally by Panum, is extremely rare in man, probably owing to the smallness of the spinal arteries and the fact that they arise at right angles. The symptoms by which emboli manifest themselves are not definitely known; possibly there is a connection between embolic processes and the so-called choreic movements, but this is still hypothetical.

It is about the same with arterial thrombosis, the independent existence of which is, to say the least, doubtful, but since,

as Leyden has pointed out (*Rückenmarkskrankheiten*, ii, 41), disease of the spinal vessels is extremely common, the occurrence of arterial thrombosis is very easily possible. Not only the inflammatory processes in the spinal cord, which are accompanied by arterial disease, but also the senile changes, which consist in fatty degeneration and thickening of the vessel walls, predispose to it. The necrosis which occurs in the substance of the spinal cord in consequence of arterial obstruction is similar to that described on page 244 as occurring in the brain substance. The condition of softening is called myelomalacia (cf. also Redlich, *Ueber eine eigenthümliche, durch Gefäßdegeneration hervorgerufene Erkrankung der Rückenmarkshinterstränge*, *Prager Zeitschr. f. Heilkunde*, 1891, xii).

3. *Endarteritis (syphilitica).*

That the spinal arteries participate in the process which Heubner has shown to occur in the cerebral arteries (page 252), according to competent observers, does not seem to admit of doubt. It is equally certain that this process plays here a relatively smaller rôle than in the brain. Heubner himself, Knapp, Leyden, and others have reported interesting observations bearing on this, and it seems that an endarteritis obliterans in the spinal cord leads either to a myelitis or a multiple sclerosis. Rumpf, in his excellent treatise on *The Syphilitic Diseases of the Nervous System* (page 349), has published in full a very interesting case of syphilitic disease of the spinal arteries, which was followed by a similar report by Knapp (*Neurol. Centralblatt*, 1885, 21), and another by Graeff (*Arch. f. Psych. und Nervenkr.*, 1882, xii, 3). There are, however, only comparatively few cases to be found in the literature, and, in almost all, syphilis of the brain coexisted with syphilis of the spinal cord, and endarteritis obliterans was almost always demonstrable in the brain as well. Two interesting cases have been reported by Schmaus (*Deutsch. Arch. f. klin. Med.*, 1889, vol. xlv, 2, 3, p. 244). In one of them the syphilitic affection took the form of an arterial disease, running a subacute course with hyaline fibrous thickening of the intima and simultaneous inflammatory infiltration of the whole vessel wall, which was followed by an irregular disseminated patchy sclerosis of the white matter, a marginal sclerosis, and a degeneration of Goll's columns in the cervical cord. That the degeneration of the nerve parenchyma was attributable to the low

state of nutrition in consequence of diminution in the blood supply seemed beyond doubt. As for the symptoms, sensory disturbances (pains, paræsthesias, hyperæsthetic zones) and motor disturbances (at first fatigue and finally complete paraplegia), furthermore incontinence of the urine and fæces, constituted the clinical picture. In the second case a syphilitic degeneration of the vessel walls combined with a poliomyelitis was found. With our present knowledge we must content ourselves with diagnosing a diffuse affection of the spinal cord, a transverse myelitis, a tumor, and the like. The diagnosis of a syphilitic disease of the arteries must be made with reservation during life, and must only be assumed when the luetic history is certain.

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4. Dilatation of the Spinal Arteries.

We know very little about aneurisms of the spinal arteries. Besides the case reported by Liouville, which is also quoted by Leyden (*loc. cit.*, 2, p. 42), none can be found in the literature. The question, therefore, whether syphilis may give rise to aneurisms here can not be answered. It is possible that bodily exertion has a predisposing action. A symptomatology and a therapy do not exist for aneurisms of the spinal cord. (Spencer, Sequel of a Case of Traumatic Aneurism of the Spine, Brit. Med. Journ., 1891, December 5.)

5. Neuroses of the Spinal Arteries.

The vaso-motor nerves of the spinal arteries behave just like those that supply the cerebral vessels, and upon whether they are in a state of irritation or in one of paralysis the amount of blood in the spinal cord depends. But easy as it is to demonstrate hyperæmia and anæmia of the cord in the cadaver, it is difficult, on the other hand, to say in what way changes in the amount of blood in the spinal cord influence the health of the patient, and whether a greater or lesser fullness of the vessels, or frequent fluctuations between the two, are attended with any marked symptoms. All views on this subject are entirely hypothetical. The pathological changes in the spinal

cord, due to an artificial transient anæmia produced by ligation of the abdominal aorta, Spronck (*Arch. de physiol. norm. et pathol.*, September 1, 1888, xx), following out the early researches of Brieger and Ehrlich, has lately demonstrated, without, however, throwing any further light upon the clinical symptoms caused by spinal anæmia.

Since the time of Peter Franck (1791) there has been a widespread opinion that hyperæmia of the spinal cord can give rise to a number of symptoms of irritation, some of which being motor, some sensory, together make up the clinical picture of what has been described as spinal irritation. But the fact that it was found impossible to accurately define a clinical picture indicative of this condition and the difficulties which arose in the diagnosis have led most observers to abandon the term. The disease used to be described somewhat as follows: The patients, who, as a rule, are females belonging to the best classes of society, complain of an occasional feeling of fatigue and of pains in the back, which are intensified by the erect posture. Walking becomes difficult, and the gait is that of an old person; they walk with a bent back and take each step with care. Painful sensations, paræsthesias, formication, and numbness in the lower extremities are complained of. The functions of the bladder are more or less disturbed; often there exists a uterine catarrh. The patient is low-spirited, and has a tendency to hypochondriacal notions. On examination, we find the reflexes either normal or exaggerated; sensibility is somewhat affected, and disseminated anæsthetic plaques are demonstrable. A certain tenderness over the vertebræ is almost always noted; it is usually more pronounced in the lumbar and dorsal than in the cervical region. The course of the disease is eminently chronic; often months and years pass, notwithstanding all therapeutic measures, before any decided improvement occurs, and those unfavorable cases in which the patient finally becomes bed-ridden and, after having been for years affected with paresis or paralysis, falls at last a prey to an intercurrent malady, are by no means exceptional. A cause was often looked for in vain. Overexertion or sexual excesses were regarded as sometimes indirectly giving rise to the disease; at times the immoderate indulgence in tobacco was blamed, but more frequently all such factors were wanting, and a congenital weakness of the nervous system had to be made responsible for the affection.

Further investigations must teach us to what extent the affection described by Möbius under the term *akinesia algera* is qualified to replace "spinal irritation." Certainly only the severest form of the latter could be represented by this condition, which, according to Möbius, is characterized by severe pain on the slightest exertion, so that there exists a total inability to move. The observations of Möbius have been confirmed by many others, but it is not yet clear whether the condition represents a separate disease or not.

The treatment in this condition, just as was the case for spinal irritation, should be local and general. The former consists in the early and energetic use of the Paquelin cautery and of the constant current (descending); the latter in the use of tepid baths and tonics. Yet often all measures are fruitless, and it is advisable to be very guarded in giving an opinion with regard to the duration and probable outcome of the disease.

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That a chronic anæmia of the substance of the spinal cord may give rise to a paralysis, especially of the lower extremities, which may last for years, seems probable according to the thesis of Meunier (Paris, 1886), yet nothing certain can be said, especially as in the cases in question it may be difficult to exclude hysteria.

Just to what class we must assign those instances of paralysis, described more especially by Russell Reynolds, which depend on the imagination—whether they are due to functional disturbances in the spinal cord, or whether, under the influence of psychical activity in consequence of auto-suggestion, a disease of the whole nervous system develops—is not known.

The various disturbances in the sexual functions—for instance, the impotentia coeundi, which is quite a common manifestation of a functional disturbance of the spinal cord in young and middle-aged men—we shall enlarge upon in the chapter on neurasthenia.

II. INFLAMMATORY PROCESSES IN THE SUBSTANCE OF THE SPINAL CORD.

1. Purulent Myelitis—Abscess of the Spinal Cord.

While circumscribed pus formations in the brain substance are by no means rare, the formation of an encapsulated pus focus in the spinal cord is one of the greatest exceptions. Although Leyden succeeded in producing such foci experimentally in dogs, the clinical observations in man are so few that it is impossible to formulate from them a definite symptomatology. Pathologically, it is interesting to note that Ollivier and Jaccoud (quoted by Leyden, *loc. cit.*, ii, 205) have seen abscesses which varied in size from that of a bean to that of a hazel-nut and were filled with a greenish-white pus. They were situated some in the cervical, some in the dorsal cord. The symptoms, on the whole, were those of a grave, acute softening. In an article by Ullmann (*Zeitschr. f. klin. Med.*, 1889, xvi, 2, page 39) an interesting discussion on spinal abscesses and an exhaustive collection of references will be found.

2. The Non-purulent Myelitis.

Inflammatory processes in the spinal cord are very frequent. In the majority of cases they are of a chronic type and less often acute. With reference to their situation, we have already stated that they may implicate the white as well as the gray matter.

A. The Acute Form.

As we said on page 449, we have in acute myelitis a process which is characterized by the death of the nerve elements and a secondary increase of the connective tissue. In the acute stage a change in the consistence of the cord takes place; the parts become softened and appear swollen and infiltrated. Sections of the cord are not so distinct, and the demarcation between the white and gray matter is less sharp. The color may be reddish (hæmorrhagic), yellowish-red, rusty brown, whitish, or of any intermediate shade. The extent of the process of softening varies. It may be spread over the whole or only a part of the cross-section, and may extend longitudinally for a greater or less distance. Sometimes disseminated foci are found not only in the cord, but can also be demonstrated in the brain. We shall speak about these later.

In exceptional cases, which are difficult to explain, abso-