CONCUSSION OF THE SPINAL CORD
IN BATTLE CASUALTIES

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In civil practice acute injuries of the spinal cord are almost invariably
associated with dislocation or fracture of the vertebral column, and the
clinical picture of transection and compression of the spinal cord from
these causes is well known. In all cases of acute injury of the spinal cord—
contusion, laceration, compression, transection, penetrating wounds or con-
cussion—the phenomenon of spinal shock develops immediately and lasts
for a few hours to months. According to Munro, as the result of the pres-
ence of spinal shock, “all reflex activity below the level of the injury becomes
chaotic, unpredictable, variable and devoid of any diagnostic or prognostic
significance.”8,9 He also emphasized the possibilities of rehabilitation in these
otherwise discouraging cases by an aggressive course of good nursing, good
nutrition and the use of tidal drainage of the bladder.

Transient paralysis as the result of injury of the spinal cord may occur
under circumstances in which a direct blow or compression of the cord is
not evident, and may be followed by partial or complete recovery in a few
hours to a few months. These fortunate individuals represent spinal shock
from concussion, rather than laceration or contusion of the spinal cord.

Concussion has been more thoroughly studied in regard to the brain
than to the spinal cord. Experimentally it is shown to be a phenomenon
consequent to sudden change of acceleration or of pressure of the brain sub-
stance.2,3,11 It is therefore found in isolated form in the “closed” type of
head injury and may be minimal or absent in cases in which there is a
penetrating type of head wound. The concept that cerebral concussion is a
traumatic paralysis has been challenged by Walker, Kollros and Case,11
who, on the basis of electroencephalographic and other delicate measure-
ments on experimental animals during the moment of impact, emphasized
the excitatory phase of the reaction. It is their contention that the paralysis
following injury is analogous to the depression following other types of
cerebral stimulation. A similar concept of concussion in peripheral nerve,
induced by an air blast, was presented by Krems and co-workers.2 Denny-
Brown2 expressed disagreement with this viewpoint and pointed out that
convulsive manifestations are rarely present in cases of cerebral concus-
sion. It is generally agreed that synaptic transmission is affected by less
intense injury than is the neuron as a whole.

The term “concussion of the spinal cord” has been used in two senses.

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Hassin described as cases of concussion some in which trauma led to no immediate dysfunction of the spinal cord but was followed in a few days by symptoms and pathologic changes, sometimes simulating degenerative changes encountered in cases of amyotrophic lateral sclerosis.

In the other definition, concussion of the spinal cord is considered to be "that which happens after a single violent impact to the vertebral column, when the function of the spinal cord is affected though no gross anatomical changes can be found." We shall adhere to the second definition. While subsequent investigation may prove this erroneous, we shall presume that "concussion" is a similar phenomenon throughout the nervous system and that comparison of concussion of the spinal cord to cerebral concussion is justified.

EXPERIMENTAL CONCUSSION OF THE SPINAL CORD

The quantitative effects of measured trauma to the spinal cord were studied by Allen in 1911. He made no attempt to distinguish the effects of contusion and concussion nor to evaluate the result in terms of acceleration but found that an impact of 340 gm.-cm. gave every expectation of uninterrupted recovery. By dropping a 30 gm. weight from a height of 11.5 cm. (impact of 340 gm.-cm.) onto the exposed spinal cord of dogs he produced spastic paraplegia, which largely disappeared in a week or ten days.

More recently, experimental concussion has been studied by Groat, Rambach and Windle. They produced concussion in cats by a blow over the spine with a blunt wood instrument. They used the threshold stimulus of a reflex arc to determine the severity of the reaction. The degree of functional interruption and longitudinal extent of involved cord was found to be correlated with intensity of the blow applied. Immediate and delayed cytologic changes were also found.

CLINICAL OBSERVATIONS ON CONCUSSION OF THE SPINAL CORD

We have had an opportunity to observe a number of injuries of the spinal cord in an Army general hospital designated as a neurosurgical center (Lawson General Hospital). These have included transections of the spinal cord, both from battle wounds and from fracture-dislocations of the spinal column. There have also been a number of partial lesions and lesions with varying degrees of recovery. It is recognized that this case material may be artificially selected as a result of the Army casualty evacuation system but the consistency of the clinical picture lends the suggestion of validity.

Of a total of 85 cases of injuries of the spinal cord assessed, a diagnosis of true concussion of the spinal cord appeared justified in only 8 cases. These presented a similar picture, in that the lesion was caused by through-and-through (perforating) bullet wounds, which passed transversely near the spinal cord, striking bone or barely missing the lamina, and in that paralysis of the extremities persisted from a few hours to a few weeks. Holmes, in the Goulstonian lectures near the beginning of the First World War, gave