



FORENSIC CHARACTERISTICS OF SPINAL CORD INJURIES IN PEDESTRIANS INJURED IN COLLISIONS WITH VEHICLES

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Article history:

Received: June 26th 2024

Accepted: July 24th 2024

Abstract:

Spinal cord and spinal cord injuries in the structure of injuries of the musculoskeletal system account for up to 17.8%, after which, with complicated spinal cord lesions, persistent disability develops in 80.0-95.0% of patients. The forensic aspects of spinal cord injuries have not been systematized to date. In order to identify the mechanism of formation and morphological features of damage to the structures of the spine and spinal cord in pedestrians injured in an accident, the results of forensic examinations were analyzed in relation to 215 corpses of adults, as well as the corpses of 140 children who died in collisions with moving cars. It has been established that the formation of cervical-occipital trauma in adult pedestrians injured in an accident is associated with phase 1, and the nature of damage to the structure of the cervical and upper thoracic spine, having a rotational distraction character with traumatization of their posterior processes and often the separation of the spine at the level of fractures, indicate their occurrence in the 1st and the 2nd phases of car injury. In pedestrian children injured in an accident, in the structure of spinal cord injury, injuries to the upper and lower middle vertebrae (distraction and rotation) are often observed, which sometimes occur with the separation of the spinal column and spinal cord in the fracture area. These data indicate that damage to these structures occurs in the 1st phase (injury of the thoracolumbar spine) and in the 2nd phase (injury of the cervical spine) of an automobile injury.

Keywords:

RELEVANCE: Spinal cord and spinal injuries account for up to 17.8% of all musculoskeletal injuries, after which 80.0-95.0% of patients with complicated spinal cord injuries develop persistent disability. Mortality reaches up to 37.0-38.3% at the pre-hospital stage and in hospital from 8 to 58.3%. In case of cervical spine injuries with severe spinal cord damage, disability and mortality reaches 98.0%, and therefore injuries to various structures of the spine and spinal cord remain the most pressing medical, social, demographic and economic problem for all countries to this day [Krylov V.V., Grin' A.A., et al. 2016; G.P. Kotelnikova, S.P. Mironova, 2018; Tolkachev V.S., Bazhanov S.P., 2018; Byvaltsev V. A., Kalinin A. A., et al., 2021; Mirzaeva L. M., 2020; Chen Y, He Y, DeVivo MJ., 2016; Liebsch K., Wilke H. J., 2022; Pfeifer R., Teuben M., et al, 2016; Yadollahi M, Paydar S, et al, 2016]. The main circumstances of injury in the origins of spinal cord injuries from the impact of blunt objects are road traffic injuries, as well as falls from a height and various other illegal actions (beatings, hooligan injuries, etc.). Under these circumstances of injury, as a rule, there is a need to conduct a forensic medical examination to establish the nature, duration, mechanism, severity of injuries in victims, and in case of a fatal outcome of the injury - to establish the main and immediate cause of death and substantiate the thanatogenesis of traumatic disease of the spinal cord in cases of death of victims in the late period of injury. These and other forensic aspects of spinal cord injuries have not yet been systematized. [Solokhin A.A., 1968; Pigolkin Yu.I. et al., 2016; Dubrovin I.A., Sedykh E.P., Mosoyan A.S., 2018; Lau E, Ong K, et.al, 2008; McMordie JH, Viswanathan VK, Gillis CC., 2023]. The aim of the study is to identify the mechanism of formation of damage to the structures of the spine and spinal cord in pedestrians injured in collisions with moving vehicles.

MATERIALS AND METHODS OF THE STUDY



The results of forensic examinations of 215 corpses of adults, as well as the corpses of 140 children who died in collisions with moving vehicles, were analyzed.

During the analysis, the nature, localization, frequency and volume of tissue and organ damage in the deceased were studied and analyzed in detail. Within the framework of variation statistics, the reliability criterion of damage indicators - t was determined, their minimum error (m) and the reliability of differences (p) between the indicators were determined.

RESULTS AND DISCUSSION.

It was found that 94.1% of deceased adult pedestrians had a combined injury (CI) of 2 or more body parts. The predominant types of ST were head, chest, abdomen and fractures of the bones of the extremities (55.8%) and head, chest, abdomen ST (23.4%). Other types of ST comprised from 4.0 to 11.0%. Spinal cord injury (SCI) in deceased pedestrians was detected in 58 cases (26.97%): compression-explosive fractures of the spine were noted only in 6 cases, in the remaining 52 cases there were distraction and rotational fractures, while in 17 cases with SCI there was a complete rupture of the spinal cord at the level of fractures of the vertebral structure. Vertebral fractures were often observed between the vertebrae (23). The results of the analysis of the forensic medical examination reports of children's corpses showed that in car collisions, child pedestrians most often develop a craniocerebral injury (78%), as well as a combined injury (CT) of the chest (-40.6%), abdomen - (50.2%) and spinal cord injury (SCI) - 25.7% and fractures of the bones of the extremities - (55%). Spinal cord injuries (SCI) in child pedestrians were detected in 36 (25.7%) of 140 cases, with isolated in 1 case, and in the remaining 35 deceased SCI was combined with trauma to other parts of the body. In SCI, damage to the cervical and thoracic spine was most often noted - 27 and 19 cases, respectively, fractures of the lumbar spine in isolated 1 case, combined SCI of the cervical and thoracic spine was noted in 12 cases. In the structure of SI, the upper cervical spine injury prevailed — cervicoccipital injury (COI) — in 21 of 27 cases, and injury to the lower cervical vertebrae (C3 and C4) — in 6 cases. In the thoracic spine, fractures of the upper thoracic vertebrae (Th-Th4) and, accordingly, damage to the structure of these parts of the spinal cord were most often observed (7). Fractures of the lower thoracic vertebrae (Th10-Th11) were detected only in 2 cases. Fractures of the thoracic vertebrae were of a distraction and rotational nature. In most cases (24 of 36), with SI, a complete rupture of the spinal cord was found in the area of vertebral fractures. The nature of SI indicated that they occurred in the 1st (injury to the thoracolumbar region) and in the 2nd (injury to the cervical region) phases of the car accident. According to researchers, the cervical spine is most often damaged by different types of blunt trauma.

- from 20 to 55% of cases. Cervical vertebrae fractures are more often combined with TBI, while thoracic fractures are often combined with chest trauma, and with damage to the lumbar spine, pelvic, abdominal organs, and lower extremity injuries may be observed [Voronovich I.R., Beletsky A.V., Dulub O.I., et al. 2007, Cheremisina V.M., Ishchenko B.I., 2003; Soloviev V.A., Telezhkin V.V., Soloviev I.V. 2007].

The nature and morphology of injuries to the cervical spine in different types of blunt trauma are determined by the mechanism of injury. Solokhin A.A. (1968) believed that spinal injuries in collisions of cars with pedestrians (run-overs) are formed both by impact with protruding parts of cars (phase 1) and by flexion and extension of the spine in the second phase of injury. Therefore, victims may have fractures of the bodies, arches, spinous processes of the thoracic and lumbar spine, as well as damage to the ligamentous apparatus of the intervertebral discs [Solokhin A.A. 1968]. Matyshev A.A. (1969) noted fractures of the thoracic spine in only 10% of cases of car runs over pedestrians, with comminuted fractures of the vertebral bodies being detected. Fractures of the spinous processes were observed in car impacts only from behind the victim, with, as a rule, single processes (1-2-3-x) being damaged. Driving a car wheel over the victim's back most often leads to the avulsion of the spinous processes of the vertebrae, as well as to fractures of their arches and bodies. In this case, damage to the vertebral bodies is more often of a luxation and less often of a compression nature, with predominant localization in the thoracic region. However, fractures of the spinous processes of the vertebrae are also possible when a car drives over the anterior surface of the chest, but in this case, fractures of a small number of spinous processes occur [Matyshev A.A. 1969].

The data presented indicate that the formation of damage to the structure of the spine and spinal cord depends on the type and model of cars, as well as on the age of the victims.

The nature and morphology of damage to the spinal cord in different types of blunt trauma are determined by the mechanism of damage. It has been established that direct impact of a blunt object results in comminuted fractures of the bodies and processes of the vertebrae, falling from a height results in compression (explosive) comminuted fractures of the vertebral bodies, excessive flexion of the spine results in dislocations with ligament rupture, and excessive extension, such as in an in-car accident, results in dislocations and wedge-shaped compression of the cervical vertebrae (whiplash injuries). Sudden extension, such as hanging, results in a complete transverse spinal cord injury in the cervical spine, causing instant death. When falling on the chin, fractures of the lower angle of C2, C5, C7 (drop-shaped wedging) occur, while with rotation and excessive flexion, a unilateral dislocation with a rupture of the ligamentous apparatus develops [Pigolkin Yu.I., Popov V.L., Dubrovin I.A. 2011].



CONCLUSIONS

1. The formation of cervical-occipital trauma in adult pedestrians injured in road accidents is associated with the 1st phase, and the nature of damage to the structure of the cervical and upper thoracic spine, which have a rotational-distraction nature with trauma to their posterior processes and often a rupture of the spine at the level of the fractures, indicate their occurrence in the 1st and 2nd phases of car trauma; 2. In children pedestrians injured in road traffic accidents, in the structure of the spinal cord injury, injuries to the upper cervical and lower middle vertebrae (distraction and rotational) are often observed, which sometimes occur with a rupture of the spinal column and spinal cord in the area of the fractures. This condition indicates that such a feature of damage to these structures occurred in the 1st phase (trauma to the thoracolumbar spine) and 2nd phase (trauma to the cervical spine) of the car accident.
3. Identification of the nature, localization and morphological features of damage to the structures of the spine and spinal cord under different circumstances of blunt mechanical trauma is important both for substantiating the mechanism of PMP, as well as for choosing methods for treating injuries to these structures.
4. In this regard, further study of the features of the formation of PMP in different types of injuries from the impact of blunt objects is promising.

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World Bulletin of Public Health (WBPH)

Available Online at: <https://www.scholarexpress.net>

Volume-38, September 2024

ISSN: 2749-3644

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