



PEDIATRIC ROAD TRAFFIC INJURIES AND THEIR CONSEQUENCES

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Abstract. Pediatric road traffic injuries remain one of the leading causes of mortality and long-term disability worldwide. The high-energy mechanisms involved in road traffic accidents (RTAs) result in a predominance of combined and multiple injuries affecting vital organs and systems. This study analyzes the structural and clinical characteristics of injuries sustained by children involved in RTAs, based on hospital clinical data and forensic autopsy findings. Traumatic brain injury, thoracic and abdominal trauma, and complex polytrauma were identified as the most frequent and prognostically significant injury patterns. Fatal outcomes were primarily associated with massive hemorrhage due to severe damage to parenchymal organs and critical thoracic structures. Anatomical and physiological features of the pediatric body contribute to extensive internal organ damage even in the absence of pronounced skeletal injuries. The findings emphasize the importance of early recognition of leading injuries, rapid diagnostic assessment, and timely surgical and intensive care interventions to reduce mortality in pediatric road traffic trauma.

Keywords: pediatric trauma; road traffic accidents; polytrauma; traumatic brain injury; thoracoabdominal trauma; mortality; hemorrhagic shock.

ТРАВМЫ ДЕТЕЙ В РЕЗУЛЬТАТЕ ДОРОЖНО-ТРАНСПОРТНЫХ ПРОИСШЕСТВИЙ И ИХ ПОСЛЕДСТВИЯ

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Аннотация. Дорожно-транспортный травматизм у детей остается одной из ведущих причин смертности и инвалидизации в педиатрической популяции. Высокая кинетическая энергия травмирующего воздействия при дорожно-транспортных происшествиях (ДТП) обуславливает преобладание сочетанных и множественных повреждений, затрагивающих жизненно важные органы и системы. В статье проанализированы особенности структуры и характера повреждений у детей, пострадавших в ДТП, на основании клинических данных стационара и результатов судебно-медицинских вскрытий. Показано, что доминирующими являются черепно-мозговая, торакоабдоминальная и комбинированная травма, сопровождающиеся высокой летальностью, преимущественно вследствие массивной кровопотери и тяжелых повреждений паренхиматозных органов. Отмечено, что анатомо-физиологические особенности детского организма способствуют тяжелому поражению внутренних органов при минимальных внешних признаках травмы. Полученные данные подчеркивают необходимость ранней диагностики, приоритизации ведущего повреждения и агрессивной противошоковой терапии для снижения летальности при детском дорожно-транспортном травматизме.

Ключевые слова: детский травматизм; дорожно-транспортные происшествия; сочетанная травма; черепно-мозговая травма; торако-абдоминальные повреждения; летальность; массивная кровопотеря.

BOLALAR YO'L-TRANSPORT JAROHATLARI VA ULARNING OQIBATLARI

Annotatsiya. Bolalarda yo‘l-transport hodisalari bilan bog‘liq jarohatlar bolalar o‘limi va nogironligining yetakchi sabablaridan biri bo‘lib qolmoqda. Yo‘l-transport hodisalarida yuqori energiyali mexanik ta‘sir natijasida hayot uchun muhim bo‘lgan a‘zolar va tizimlarni qamrab oluvchi ko‘p sonli va qo‘shma shikastlanishlar ustunlik qiladi. Ushbu maqolada statsionar klinik ma‘lumotlar hamda sud-tibbiy ekspertiza natijalari asosida YTHda jarohatlangan bolalarda shikastlanishlarning tuzilishi va xususiyatlari tahlil qilindi. Tadqiqot natijalari shuni ko‘rsatdiki, yetakchi o‘rinni bosh miya jarohatlari, ko‘krak va qorin bo‘shlig‘i shikastlanishlari hamda qo‘shma travmalar egallaydi. O‘lim holatlarining asosiy sababi parenximatoz a‘zolar va hayotiy muhim tuzilmalar shikastlanishi natijasida rivojlangan massiv qon yo‘qotish hisoblanadi. Bolalar organizmining anatomik-fiziologik xususiyatlari tashqi belgilar kam bo‘lgan holda ichki a‘zolarining og‘ir shikastlanishiga olib kelishi mumkin. Olingan natijalar erta diagnostika, yetakchi jarohatni aniqlash va intensiv davolash choralarining ahamiyatini ko‘rsatadi.

Kalit so‘zlar: bolalar travmatizmi; yo‘l-transport hodisasi; qo‘shma jarohat; bosh miya jarohati; ko‘krak-qorin travmasi; o‘lim ko‘rsatkichi; qon yo‘qotish.

Introduction. Road traffic injuries remain one of the most severe forms of trauma worldwide and represent a leading cause of morbidity and mortality among the pediatric population. The lethality of transport-related trauma reaches approximately 15%, which is dramatically higher than the overall mortality associated with general trauma, estimated at about 0.6%. This discrepancy reflects not only the high-energy mechanisms involved in road traffic accidents (RTAs), but also the predominance of polytrauma with simultaneous involvement of multiple anatomical regions and vital organs. According to national health reports, including the State Report on the Health Status of the Population of the Russian Federation, a steady increase in the incidence of injuries among children has been observed, with a documented rise of 2.4% within a single year. Transport-related trauma accounts for more than half of all traumatic injuries in children, ranging from 52.5% to 62%, and is characterized by a combined injury pattern in up to 86.4% of cases.

A defining feature of pediatric road traffic trauma is its combined and multisystem nature, which significantly complicates clinical assessment, prioritization of injuries, and therapeutic decision-making. One of the most critical challenges in managing such patients is the identification of the leading injury, as it often determines the immediate threat to life and the sequence of diagnostic and therapeutic interventions. Numerous thoracic surgeons and trauma specialists emphasize that in nearly half of fatal road traffic injuries, thoracic trauma constitutes the primary cause of death. In children, injuries to the chest are associated with particularly high severity due to anatomical and physiological characteristics, including increased chest wall compliance, incomplete ossification of the rib cage, and a higher propensity for visceral damage without overt skeletal fractures. In more than 80% of pediatric patients with chest injuries, there is concomitant damage to multiple organs and systems.

Abdominal trauma represents another dominant injury pattern in pediatric RTAs and ranks among the leading causes of death. It is identified in approximately 30% of fatal transport-related injuries and in about 5% of all road traffic accidents. A significant proportion of deaths resulting from combined trauma occur at the prehospital stage or within the first three hours after admission to intensive care units, underscoring the critical importance of early recognition, rapid transport, and timely surgical intervention. This early mortality window represents a major reserve for reducing overall trauma-related lethality at the population level.

The present study aimed to identify and analyze the structural and clinical characteristics of injuries sustained by children involved in road traffic accidents. The study was based on the results of a comprehensive examination of 104 pediatric patients hospitalized in a surgical inpatient facility following RTAs. In order to obtain a complete and objective assessment of thoracic and abdominal injuries, an additional analysis of 110 forensic autopsy reports was conducted for children who died

at the scene of the accident. The gender distribution among hospitalized children revealed a predominance of boys, who were affected 1.5 times more frequently than girls. Age-related differences in injury mechanisms were also observed: preschool-aged children were more often injured as vehicle passengers, whereas school-aged children were predominantly injured as pedestrians.

Analysis of injury patterns among hospitalized patients demonstrated that combined trauma was the most frequent presentation. Injuries to the upper half of the body, particularly the head, chest, and upper abdominal organs, were predominant. Traumatic brain injury (TBI) was identified in more than 70% of cases, a finding largely attributable to falls following impact, with direct head strikes and vehicle overrun occurring less frequently. Abdominal trauma with damage to intra-abdominal organs ranked second in frequency, followed by thoracic injuries. The high incidence of head and abdominal injuries reflects both biomechanical factors and the relative vulnerability of these regions in children.

Forensic analysis of fatal cases revealed that combined trauma was present in more than 95% of children who died at the scene of the accident. In nearly two-thirds of these cases, three or more anatomical regions were involved, while isolated injuries were exceptionally rare. Traumatic brain injury and thoracic trauma occupied leading positions among fatal injuries. The morphological spectrum of TBI was diverse and included epidural and subdural hematomas, intracerebral hemorrhages with brain compression, severe cerebral contusions, and brain tissue destruction. Combined injuries of the skull and brain were frequently observed and often involved fractures of the cranial vault or skull base with associated damage to meninges, cerebral vessels, and cranial nerves.

A distinctive feature of pediatric thoracic trauma in RTAs was the relatively low incidence of rib fractures despite a high frequency of severe intrathoracic organ damage. Rib fractures were identified in only a minority of cases, whereas injuries to the lungs, heart, major vessels, diaphragm, trachea, and bronchi were common, particularly in fatal cases. Pulmonary injuries predominated and were represented by contusions and ruptures, often occurring without concomitant skeletal damage. Morphologically, lung contusions were characterized by subpleural hemorrhages of varying size and configuration, as well as extensive hemorrhagic impregnation of the pulmonary parenchyma with formation of intraparenchymal hematomas. Lung ruptures were more frequently observed in younger children, likely due to greater tissue elasticity and susceptibility to shear forces. Abdominal injuries were identified in nearly two-thirds of both hospitalized and fatal cases, indicating that their presence alone does not determine outcome, but rather the severity and extent of organ damage. Forensic data demonstrated that fatal abdominal injuries were predominantly associated with severe damage to parenchymal organs, particularly the liver and spleen, characterized by multiple deep lacerations, capsular rupture, and extensive tissue destruction. Among hospitalized children, similar injuries were observed less frequently; however, a substantial proportion of these patients died within the first hours after admission, highlighting the critical nature of such lesions. The spleen emerged as the most vulnerable abdominal organ in surviving patients, whereas liver injuries predominated among fatalities.

The principal cause of death in both prehospital and in-hospital settings was massive hemorrhage resulting from injury to one or more parenchymal organs. This finding emphasizes the central role of hemorrhagic shock in the pathogenesis of fatal outcomes following pediatric RTAs.

Conclusion. pediatric road traffic trauma is characterized by a pronounced combined injury pattern involving multiple anatomical regions and vital organs. The presence of multisystem damage leads to an atypical or blunted clinical presentation, in which classical signs of isolated injuries may be absent or masked. This results in the development of complex and non-specific symptom complexes, complicating timely diagnosis and management. Understanding the structural and pathophysiological features of pediatric injuries sustained in RTAs is essential for improving early diagnosis, optimizing treatment strategies, and ultimately reducing mortality and long-term disability in this vulnerable population.

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