FORENSIC MEDICAL EVALUATION OF INJURIES RESULTING FROM ROAD TRAFFIC ACCIDENTS INVOLVING MODERN VEHICLES

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Introduction: Road traffic accidents (RTAs) represent one of the most significant medico-legal and public health problems worldwide. According to the World Health Organization, RTAs cause over 1.3 million deaths annually and millions of non-fatal injuries. In recent years, the structure of road trauma has changed due to the implementation of advanced automotive technologies, such as passive and active safety systems, energy-absorbing body materials, and improved vehicle ergonomics. These innovations have altered not only the frequency but also the morphology and mechanisms of injuries. Consequently, the forensic medical evaluation of trauma resulting from modern vehicle accidents requires new diagnostic criteria and interpretive approaches that integrate clinical, biomechanical, and morphological perspectives.
Aim: To study the forensic medical characteristics, mechanisms, and diagnostic principles of injuries sustained in road traffic accidents involving modern vehicles.
Materials and Methods: The study included a retrospective and comparative analysis of forensic medical reports of victims injured in RTAs over the past five years. Cases were selected based on the use of vehicles equipped with safety devices such as airbags, seat belts, and reinforced passenger compartments. Injuries were analyzed by localization, type (blunt, combined, compression), and severity according to forensic classification. Additionally, biomechanical assessment of trauma mechanisms and correlation between the injury pattern and vehicle safety elements was performed. Descriptive statistics and comparative analysis were applied to identify consistent trends.
Results: The study demonstrated that modern vehicle safety systems significantly influence the structure of traumatic injuries. While overall mortality has decreased, the profile of injuries has shifted. Airbags frequently cause localized contusions, abrasions, and burns on the face and upper extremities, whereas seat belts are associated with characteristic linear ecchymoses across the thorax and abdomen (“seat belt sign”). Cervical hyperextension and whiplash injuries remain typical for frontal impacts despite airbag deployment. Internal injuries, including cardiac contusions, splenic ruptures, and pulmonary hemorrhages, were observed even in survivors due to deceleration forces. Forensic differentiation between the driver and passengers is possible based on the asymmetry and orientation of injuries, seat belt marks, and contact traces with interior structures.
Conclusion: Forensic medical evaluation of injuries in modern road traffic accidents must take into account the design and operation of contemporary vehicle safety systems. Traditional classifications of mechanical trauma should be revised to include new injury patterns associated with airbags, seat belts, and other passive safety elements. A multidisciplinary approach combining forensic pathology, biomechanics, and vehicle engineering contributes to a more accurate determination of the mechanism and sequence of injuries, the position of victims at the moment of impact, and the overall reconstruction of the event. Such comprehensive evaluation is essential for objective forensic conclusions and for improving preventive strategies in traffic safety and medico-legal practice.