THE ROLE OF THE FORENSIC AUTOPSY IN RECONSTRUCTING VEHICLE-PEDESTRIAN IMPACT - A CASE REPORT

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Abstract

One of the most important things in forensic medicine and law practice is the correct interpretation of injuries, especially in the case of motor vehicle accidents. Injuries to the body of pedestrians in an accident occur both from the vehicle and from the contact with the ground and can be equivalent to the testimony of a witness to the accident. The information provided by the forensic medical examiner helps law enforcement and the court to find out what happened, what was the position of the deceased during the accident, how fast death occurred and in some cases the potential causes of the accident. We present a case of a 21-year-old woman who died in a motor vehicle accident, examined in the Department of Forensic Medicine and Deontology, Medical Faculty, Medical University-Sofia, Bulgaria. The analysis of all materials in the case presented, revealed contradictory testimonies regarding the events that occurred, therefore the role of forensic examination was of great importance for clarifying the case. The observed injuries on the body and the clothes of the deceased, established during a full forensic autopsy, were used to determine the most probable mechanism of occurrence.

Keywords: *Motor vehicle accident, reconstruction, pedestrian, injuries, forensic medicine*

Introduction

One of the most important things in forensic medicine and law practice is the correct interpretation of injuries, especially in case of motor vehicle accidents [1]. In most cases, the only witness is the perpetrator of the crime and his testimony is less reliable [2, 3]. Injuries to the body of pedestrians in an accident occur both from the vehicle and from contact with the ground and can be equivalent to the testimony of a witness to the accident [1, 4]. The information provided by the forensic medical examiner helps law enforcement and the court to find out what happened, what was the position of the deceased during the accident [5], how fast death occurred and in some cases the potential causes of the accident [6]. The autopsy, accompanied by an in-depth and accurate report, adequate photographic and schematic documentation and appropriate toxicological examination, plays an integral role in determining the sequence of events that led to the incident and the following death [1, 4].

When a forensic autopsy is performed, it should be complete, including examination of the head, neck, chest and abdomen, as well as the limbs when necessary [1]. In the case of pedestrian accidents, the information that can be obtained from the post-mortem examination of the corpse can be crucial in the investigation of the accident [4, 6, 7]. The forensic autopsy includes both an external examination of the deceased's clothing and skin, and an internal examination of the body

[1]. The interaction between the pedestrian and the motor vehicle and the resulting defects, stains and injuries depend on several factors, including the speed and type of vehicle, the age of the deceased pedestrian (height) and whether or not the driver attempted to stop [7, 8, 9]. In fatal cases with pedestrians the forensic expert has to make additional incisions in the back and the limbs (especially the lower ones) to look for deep soft tissue bruises and bone fractures [1]. The location of traumatic pockets, if any, should be noted. Each traumatic injury is determined at what height it is from the base of the heel of the body, and in the presence of shoes with a thick sole or heel, it is also taken into account [1, 7]. When a pedestrian is thrown on the hood and windshield of a vehicle, fractures of the pelvis, spine and ribs, as well as visceral injuries can occur [8, 10]. The distribution of these injuries can also be useful in determining the dynamics of the impact [11]. Head and neck injuries are the most common cause of death in pedestrians. Typical blunt force injuries, such as scalp tears, facial and skull fractures, epidural and subdural hemorrhages, cerebral cortex contusions, atlanto-occipital dislocation, and others, are common [1]. Head injuries can also be received when a pedestrian falls on the roadway after being hit by a vehicle [1, 3, 10].

Case presentation

We present a case of a traffic accident between a car and a wooden cart, in which one person died – a 21-year-old woman. In the pre-trial and court proceedings, transcripts of interrogations of the driver of the car and the man with whom the victim lived on a family basis, and who was involved in the accident, were presented. The driver testified that he had driven the car at a speed of 60-65 km/h, and subsequently – about 50-55 km/h, as the auto technical expertise and the complex one (without the participation of the forensic doctor who performed the autopsy) adopted concluded the speed to be about 60 km/h. The witness in the case gave contradictory testimony regarding the location of the victim, namely that she led the horse (animal traction) sitting on the wooden cart and subsequently that she led the horse walking next to him. The third version was that the horse kicked the deceased woman and killed her.

During the forensic autopsy of the corpse, as well as after the additional forensic chemical examinations, it was established (Figure 1):

- Closed craniocerebral trauma, expressed in: hemorrhage on the inner surface of the soft cranial cover on the border of the parieto-occipital region of the head on the right, on an area of 4/3 cm; hemorrhage under the meninges (subarachnoid hemorrhage) in the temporal region of the right cerebral hemisphere; hemorrhage under the meninges in the area of the bridge, medulla oblongata on the right, and on the right cerebellar hemisphere on its upper surface; fracture of the base of the skull, with the line passing transversely through the two middle cranial fossae and “sella turcica”.
- Severe cervical trauma: rupture of the intervertebral disc between the second and third cervical vertebrae; rupture of the intervertebral disc between the fifth and sixth cervical vertebrae; opening in these areas of the spine to its anterior surface; hemorrhage of the surrounding soft tissues and the spinal cord;
- Trauma in the lumbar region and lower extremities: linear abrasions and bruising in the right lumbar region; abrasion in the left lumbosacral region; hemorrhage of the deep muscles on the

posterior surface and in the soft tissues of the right thigh, posterior surfaces and deep soft tissues of the left lower leg, on two levels in the upper and lower thirds, and on the right lower leg in the upper-middle third.

- Abrasion on the anterior outer surface of the right ankle, abrasions at the base of the first toe of the right foot and the main phalanx of the same toe; superficial abrasion on the back of the nose in its lower third;
- Lack of ethyl alcohol, drugs and narcotics in the blood and urine of the corpse.
- Presence of a thick layer of clothing on the body, lack of the sole of the left boot, without stains on the base of the foot; Rupture and partial absence of the front part and the sole of the right boot, with a tear on the bottom of the right sock in the area of the toe pads.

The inspection report and the statement of findings for the specific accident refer to deformations of the car as follows: Deformed front part - bumper, apron, grille, front right fender, right headlight, hood, windshield, suspension, activated front airbags, deformed and broken parts inside on the coupe, etc. There was no detailed description of the deformation of the bonnet regarding the presence of scratches from hard blunt objects, elastic bending or impact of a solid object with a wider area, without uneven surfaces, i.e. it is not assessed whether the deformation of the bonnet is the result of impact in the front right part or there are additional damages from direct impact possibly from a human body. The above also applies to the windscreen, where the deformation may be due to bending when moving parts of the frame or may be the result of impact on the same, depending on its di- or triplex structure.

Discussion

The overall morphological complex of the injuries of the victim indicates the following mechanism of their occurrence:

The severe traumatic brain injury was the result of an impact on a hard blunt object with a wider and a relatively flat surface, with contact part to the right parieto-occipital region of the head and a focal distribution of the resulting kinetic energy in the forward direction. In this impact, hemorrhage of the soft tissues in the contact area of the head and hemorrhage under the arachnoidea occured, by the mechanism of “Contra coop” [1]. It had significant kinetic energy, which is evident from the indirect fracture of the cranial base as a result of the bending and overstretching of the bone structures in the middle cranial fossa, which occurred during the momentary deformation of the cranial box. The distribution of energy was mainly in the anterior direction, but with almost the same component of the shock wave to the brain base, where the hemorrhages in the cerebellum and medulla oblongata occurred. The craniocerebral trauma corresponded to being received after a severe cervical trauma in an extremely short period.

The cervical trauma was due to a strong bending of the spine in the cervical region [4, 5] - arising from tilting the head back, which occurred due to the given kinetic energy to the lower parts of the human body and especially to the center of gravity or below it (sacroiliac region and lower limbs). When the head is abruptly tilted, there is a backward curvature in the cervical region with rupture of the ligaments on the anterior surface of the spine in the cervical region, with rupture of the intervertebral discs and opening of the spinal canal to the spinal cord [8], and with higher localization – to the medulla oblongata. This was observed in the specific case - the

cervical trauma, also called "whiplash injury", occurred mainly by the mechanism of bending backwards and overstretching in the anterior part of the spine.

There was morphological data of an impact in the lumbar region of the body, as well as on the lower extremities, with the appearance of superficial grooved abrasions and mainly bruising of deep soft tissues. They were due to direct impact of hard blunt objects with relatively limited contact surface with the lumbar region of the body, the right thigh and both lower parts of the legs.

There was no damage to the palms and wrists, which can occur from hard blunt or semi-rigid objects, in the event of an impact and tension, caused by elements of the bridles that control the animal traction (in particular case – the horse).

The photographs taken at the accident scene indicate the complete destruction of the wooden cart (with adapted car wheels), with a basic element of bending in the middle of the same.

The comparison of the data indicates two most probable mechanisms of occurrence of the car accident:

- The victim was on the wooden cart – she could be sitting on the board meant for siting, located transversely to the longitudinal axis of the wooden cart or standing upright using this board to support herself while leading the horse. Another even less possible option, given the available injuries, is that she was sitting on the main floor of the cart. If she was controlling the horse with the bridles, as they are held in the hands, in case of a sudden stretch they come into contact with the surface of the respective anatomical area causing abrasions and bruises, due to the tangential and compressive action. If she was sitting on the board the main supporting element would have been the buttocks area, and in the event of an impact with the vehicle in the rear-forward direction with left-right components, bruising may occur on the back of the thighs from the edge of the board, as well as on the lower part of the legs during the subsequent displacement of the body backwards, in which, in addition to the impact, there is also a basic tangential action of the respective elements. In the area of the right thigh and both lower part of the legs of the victim there are bruises, without superficial or deep contact abrasions, therefore mainly the impact on them prevailed. The comparison of these data with the mechanism of abrupt bending of the neck in two main parts in the general complex of the realized mechanogenesis can be explained from a morphological point of view with the indirect mechanism of impact in the neck area, but in its entire complex together with the shoe damage is a less likely option;

- The available injuries on the body of the deceased correspond well to those arising from a car impact on a pedestrian on the back surface of the body with characteristically located injuries in the form of deep bruises, without abrasions of the skin in the lower extremities, which can occur from elements of the bumper or the protruding part of the hood of a car. The hemorrhage to the lumbar region with abrasion may arise from an already deformed element of the hood of the car. In this impact, the lower limbs correspond to have been in a basic support position on the ground in order to obtain the available damage to the soles of the boots. The lack of stains on the exposed parts of the tears indicates that they occurred in the accident. In such an impact within the center of gravity and the lower limbs, the energy of the vehicle is given to this part of the body as the upper part lags behind, especially the area of the neck where the bending occurs. In

this case there are reliable morphological data for abrupt tilting of the head backwards and overstretching of the cervical spine. These injuries can be attributed to the so-called characteristic injuries in case of a pedestrian-vehicle collision in the complex of direct and indirect impact. The hit in the area of the head was performed in the right parieto-occipital part, where no abrasions were found on the surface of the skin in the limited area of the impact, compared to the general circular configuration of the skull. This indicates an impact on an object with a wide contact surface, with simultaneous damage to the brain structures of the type of "Contra coop" and a deformation of the skull in the event of the fracture of the skull base when the head reached and broke the windshield.

The comparison of the described deformations of the car, the traumatic injuries on the body of the victim and the corresponding mechanogenesis of occurrence, compared in the general complex of the traffic accident, determines the more probable mechanism of impact between the pedestrian and the car. The established cervical trauma, examined in its entire complex and compared with the age of the victim, pointed to a more significant speed of the car of approximately 70-80 km/h. No injuries were found that could correspond to an impact of any anatomical parts of the horse pulling the wooden cart.

Conclusion

The forensic determination of traumatic injuries of deceased in traffic accidents can help in clarifying the mechanism of occurrence of the accident. In addition, the knowledge about the most common traumatic injuries and their mechanism of occurrence by emergency medical teams, can contribute to a more adequate approach in the assessment and treatment of such victims.

Statement for potential conflicts of interest: The authors declare that they have no conflict of interest.

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Figure 1. Clothes defect and injuries to the body of the deceased.

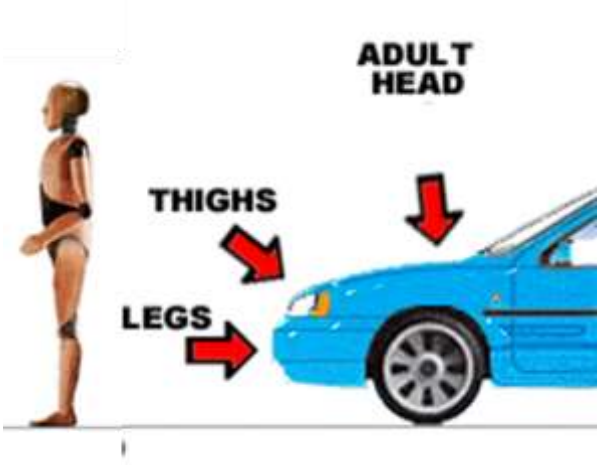

Figure 2: General view of vehicle-pedestrian impact points