

# Origin, Nature and Consequences of Modern Mechanical Trauma

Indiaminov Sayit Indiaminovich<sup>1,2,\*</sup>, Norkulov Urol Farxadovich<sup>3</sup>

<sup>1</sup>Republican Scientific and Practical Center of Forensic Medical Expertise of the Ministry of Health of the Republic of Uzbekistan, Tashkent, Uzbekistan

<sup>2</sup>Tashkent Pediatric Medical Institute, Tashkent, Uzbekistan

<sup>3</sup>Samarkand Branch of the Republican Scientific and Practical Center of Forensic and Medical Expertise, Samarkand, Uzbekistan

**Abstract** In order to identify the circumstances, structure and consequences of a mechanical injury, a retrospective analysis of the conclusions of the forensic medical examination over the past 5 years (2017-2021) was carried out. It was found that the majority of death cases from mechanical trauma was made up of males (81.2%) at the most working age of 18-60 years (90.73%). Deceased children amounted to 9.13%. The share of people who died over 60 years old fell 21.11% of cases. It was revealed that the largest number of fatal mechanical injuries was due to road accidents (67.4%), of which 65.4% are car injuries. In 62.2% of cases, the victims died at the scene of injury, in the remaining 37.8% of cases, mortality occurred in medical institutions. The largest number of deaths from mechanical trauma were in a state of high and severe intoxication (60.0%). At the same time, in 12.7% of cases of establishment of mild and 30.3% of medium degree intoxication. In the conditions of an accident and during falls, the victims had a combined and multiple trauma, covering more than 2 parts of the body, which were dominated by craniocerebral trauma, then injuries to the chest, abdomen and limbs.

**Keywords** Mechanical trauma, Origin, Character, Death, Causes, Diagnosis

## 1. Actuality of the Problem

The modern era is characterized by a steady increase in traumatism associated with a sharp increase in the number of road traffic accidents (accidents) and catatramas. In the structure of damage by blunt mechanical factors, the leading place is occupied by the number of victims of combined and multiple injuries. Around the world, about 5.8 million people die annually from similar injuries, among whom people of the most working age predominate. Mortality caused by combined trauma in specialized clinics is 18.8-36.0% and 50-60% of victims die at the prehospital stage. In this regard, injuries around the world are the most pressing socio-demographic, medical-biological and economic problem. [4,6,11,13,17,18,21].

These data dictate the need for further improvement of methods of prevention, diagnosis, treatment and rehabilitation of patients with combined trauma. In this regard, an important role is played by the analysis of the results of forensic medical examinations (SME) related to the fatal outcomes of mechanical trauma, the results of which can become the basis for the development of preventive

measures, as well as the improvement of adequate methods of treating patients with injuries of varying severity.

**Objective** - to identify the circumstances, structure and consequences of mechanical trauma.

## 2. Materials and Methods of Research

A retrospective analysis of the data of the conclusions of forensic medical examinations of corpses conducted in the Samarkand branch of the Republican Scientific and Practical Center for Forensic Medical Examination of the SME of the Republic of Uzbekistan for the period 2017-2021 (5 years) was carried out. In the process of analysis, the circumstances of injuries, the dynamics of mortality rates by year, by sex and age of the victims, as well as the nature and volume of lesions of individual parts of the body and the causes of death were revealed. Within the framework of variational statistics, the criterion of reliability of indicators ( $t$ ) their minimum error ( $m$ ) and reliability ( $p$ ) differences in indicators were determined.

## 3. Research Results and Discussion

It was established that during this period 2256 studies of the corpses of persons who died from diseases and injuries were carried out. Of these, 985 cases (44%) were associated with the death of victims of exposure to mechanical factors,

\* Corresponding author:

antonina\_amurovna@mail.ru (Indiaminov Sayit Indiaminovich)

Received: Nov. 24, 2022; Accepted: Dec. 10, 2022; Published: Dec. 23, 2022

Published online at <http://journal.sapub.org/ajmms>

the distribution of which by sex and age is given in Table No. 1.

**Table 1.** Data on the gender and age of people died by mechanical injuries

No	Age categories	By gender		n	%
		Male	Female		
1.	01-17	57	33	90	9,13
2.	18-30	161	34	195	19,7
3.	31-40	159	40	193	19,59
4.	41-50	130	16	146	14,8
5.	51-60	121	32	153	15,53
6.	61 -74	185	23	208	21,11
Total		807 (81,2%)	178 (18,07)	985	100%

From the table it can be seen that the bulk of the deaths from mechanical trauma were males (81.2%) at the most able-bodied age of 18-60 years (90.73%). The number of children who died was 9.13%. Deaths over 60 years of age accounted for 21.11% of cases.

Data on the structure of mechanical trauma by its types are given in Table No. 2.

**Table 2.** Types of mechanical trauma

No	Types of mechanical trauma	n	%
1.	Vehicle injury - total 644		
2.	By type of vehicle injury:	644	65,4%
	• Car,	5	
	• Motorcycle,	7	
	• Railway,	5	2,0%
	• Bicycle trauma,	1	
	• Vehicle trauma,	2	
• tractor injury.			
3.	Trauma from exposure to various blunt objects	193	19,6%
4.	Falls from a height	40	4,1%
5.	Trauma from exposure to sharp objects	87	8,8%
6.	Gunshot injury	1	0,1%
Total		985	100%

From the table it can be seen that the main number of mechanical injuries was caused by road accidents (67.4%), of which 65.4% is a car injury, other types of transport injury was 2.0%. Injuries and death of victims from exposure to various blunt objects (tools) is 19.6% and many cases were associated with trauma with sharp objects (8.8%) and falls from a height (4.1%). It is gratifying to note that in the structure of a mechanical injury, a single case of fire damage was caused, which is due to the lack of firearms in free circulation in the Republic.

In 62.2% of cases, victims with mechanical trauma died at the sites of injury, in the remaining 37.8% of cases, mortality did not set foot in medical and prophylactic institutions. During a forensic chemical study, 24.8% of the dead in the blood and urine were found to have ethyl alcohol, information about this is given in Table No. 3.

**Table 3.** Indicators of alcohol concentration in the blood of persons who died from mechanical trauma

No	Degree of intoxication	n	%
1	Slight intoxication	31	12,7 %
2	Moderate intoxication	74	30,3 %
3	High and severe intoxication	139	60,0 %
Total		244	100 %

It can be seen that the largest number of deaths from mechanical trauma were in a state of severe and severe intoxication (60.0%). At the same time, in 12.7% of cases, mild and 30.3% of the average degree of intoxication were established. The analysis showed that the nature, location, severity and volume of injuries on the body of the deceased depended on the type of injury. In the conditions of transport trauma (664), mainly combined or multiple injuries were detected, covering at least 2 parts of the body, which were dominated by craniocerebral traumas (CCT), then the chest, abdomen and limbs. A similar nature of the injuries occurred in the falls of the victims from a height (40), but CCT and injuries of the musculoskeletal system prevailed ( $p \leq 0.001$ ). At the death of victims from the effects of various blunt objects, tools (193), including parts of the human body during illegal actions, CCT and injuries to internal organs, mainly abdominal organs, prevailed ( $p \leq 0.001$ ). It should be noted that in the conditions of death of victims from the effects of blunt factors, injuries to the structure of the head and its facial part (open, closed CCT) were detected in 566 dead, which accounted for 58% of the total number of observations (985). At the same time, CCT conditions in 391 victims (40%) were accompanied by lesions of the bones of the skull and in the remaining 175 cases (18%) CCT were accompanied by severe brain contusion and under the membrane, also intracerebral hemorrhages. Under these conditions, CT (combined trauma) more than 2 parts of the body, as well as severe CCT, were the direct cause of death of victims at the prehospital stage ( $p \leq 0.005$ ).

In the earlier period of CT (1-3 days), the death of victims in hospitals occurred as a result of edema and dislocation of the brain, ascending edema of the spinal cord, traumatic and hemorrhagic shock, pulmonary edema, hemo and pneumothorax of fatty embolism of the vessels of the brain and lungs, and in the long term (over 3-7 days) of trauma - as a result of purulent-septic complications, pulmonary embolism, pulmonary embolism, or decompensation of somatic chronic diseases of the heart, lungs, liver and kidneys ( $p \leq 0.005$ ).

In case of damage by sharp objects (87), hollow-cut penetrating wounds with damage to internal organs prevailed. Along with this, there were injuries from the effects of cutting objects, as well as cut and puncture wounds on various parts of the body. The immediate causes of death of victims of injuries with sharp objects were massive blood loss, hemo and pneumothorax, cardiac tamponade and in some cases - air embolism. With a gunshot injury, the death of the victim occurred as a result of through gunshot wounds

to the chest and abdomen with damage to internal organs, complicated by massive blood loss, hemo and pneumothorax.

In the structure of modern combined and multiple injuries, damage to the structure of the skull and brain (CCT) is diagnosed in at least 75% of victims. CCT worldwide to date remains the most pressing medical, social and economic problem due to its prevalence and severity of consequences [22]. The main causes of CCT are accidents and falls from a height. Damage to the structure of the breast and organs of the chest cavity is also one of the most commonly observed injuries, which in absolutely most cases are accompanied by traumatic, pleuropulmonary shock, manifestations of hemo and pneumothorax, and as a result of damage to the organs of the chest cavity. These conditions, along with trauma to the structure of other parts of the body, most commonly the head and abdomen, are the direct cause of death of victims at the pre-hospital stage from combined trauma (CT). According to a number of authors, damage to the structure of the breast, among the causes of mortality occupies one of the leading places, second only to CCT [5,12,24]. As part of CT, closed injuries to the structure of the chest and organs of the chest cavity are observed 9 times more often than open (penetrating and non-penetrating) injuries, which can be accompanied without damage (71.8%) and with damage to internal organs (28.2%). The nature of the damage can vary from ordinary bruising to gross damage - to complete separation of internal organs, accompanied by massive blood loss. With combined breast trauma, damage to the structure is often observed. spine and spinal cord [9,28].

Damage to the structure of the abdominal organs, with different types of mechanical trauma, is 21-25% and does not tend to decrease [18,20]. At the same time, intestinal damage ranges from 6.3 to 38.5%, mortality reaches up to 12-24% [1,3,8], which are the most common cause of peritonitis. With traumatic effects, the liver and spleen are also often damaged, leading to massive blood loss and hemorrhagic shock [7,14,15,29].

Injuries to the structure of the pelvis is one of the severe injuries of the musculoskeletal system and is a fairly common cause of disability (22-66.7%) and mortality of patients - 46.3%. Among the victims with pelvic trauma, men prevail (73%) in the most working age - 25-55 years. [2,16,27].

Damage to the musculoskeletal system is observed in more than 92% of victims with CT, in which in 22-43% of cases of damage to these structures in the composition of CT is domic [4]. Fractures of the bones of the limbs in CT in 42-64% of victims are multiple and complex, which, according to the classification of AO / ASIF, qualify for type B and C and they are most often open [25]. In this regard, early osteosynthesis of long tubular bones and fixation of unstable fractures of other structures of the musculoskeletal system significantly reduces the lethality of patients [23].

CT of the limbs is most often accompanied by simultaneous damage to various segments of the skeleto-muscle structure of the body. At the same time, there

is a very diverse combination of them both in localization and in the nature and severity of injuries. In this regard, the problem of providing medical care to victims with CT of the limbs, to date, continues to be the most complex and finally unresolved problem of modern traumatology and orthopedics [10,19,26].

These data indicate the necessity to analyze the nature, size, complications of damage to individual parts of the body to establish the role of each injury in the mechano and thanatogenesis. This is our next plan of study.

## 4. Conclusions

1. In the materials of forensic medical examination, fatal mechanical trauma accounts for 44% of the total number of expert studies conducted. The majority of those died from mechanical trauma are males (81.2%) at the most working age -18-60 years (90.73%).

2. The main number of mechanical injuries was caused by road accidents (67.4%), of which 65.4% is a car injury. In 62.2% of cases, victims with mechanical trauma died at the sites of injury, in the remaining 37.8% of cases, mortality was received in medical institutions. During a forensic chemical study in the blood and urine of 24.8% of the dead, ethyl alcohol was found, the concentration of which in the blood of most of the dead corresponded to a strong and severe degree of intoxication.

3. The nature, location, severity and extent of body injuries in the deceased depended on the type of injury. In the conditions of transport trauma, basically, combined or multiple injuries were detected, covering more than 2 parts of the body, which were dominated by craniocerebral traumas (CCT), then - the chest, abdomen and limbs. A similar nature of the injuries occurred during the falls of the victims from a height, but CCT and injuries of the musculoskeletal system prevailed. At the death of victims from the effects of various blunt objects, tools, including parts of the human body during illegal actions, CCT and injuries to internal organs, mainly abdominal organs, prevailed.

4. Injuries to the structure of the head and its facial section (open, closed CCT) were detected in 58% of the victims. At the same time, CCT conditions in 40% of the dead were accompanied by lesions of the bones of the skull and in the remaining 60% of cases - CCT occurred with severe brain contusion and under the sheathing, as well as intracerebral hemorrhages, which were the direct cause of death of the victims at the pre-hospital stage.

5. In the earlier period of CT (1-3 days), the death of the victims occurred as a result of edema and dislocation of the brain, ascending edema of the spinal cord, traumatic and hemorrhagic shock, pulmonary edema, fatty embolism of the vessels of the brain and lungs, and in the distant period (over 3-7 days) of trauma - as a result of purulent-septic complications, pulmonary embolism or decompensation of somatic chronic diseases of the heart, lungs, liver and kidneys.

6. With damage by sharp objects, hollow-cut penetrating wounds with damage to internal organs prevailed. The immediate causes of death of the victims were massive blood loss, hemo and pneumothorax, cardiac tamponade and, in some cases, air embolism. With a gunshot injury, the death of the victim occurred as a result of through gunshot wounds to the chest and abdomen with damage to internal organs, complicated by massive blood loss, hemo and pneumothorax.

7. These data should be taken into account in the process of forensic diagnosis of mechanical trauma, as well as in the provision of emergency and emergency medical care to victims and in the development of preventive measures to prevent injuries. To establish the role of injuries of individual structures in the mechano- and thanatogenesis of traumatic illness, it is necessary to conduct a detailed analysis of the nature of the volume and complication of damage to various parts of the body.

## REFERENCES

- [1] Alishikhov A.M., Puzanov S.Yu., Bogdanov D.Y. Results of endosurgical diagnosis and surgical treatment of thoracoabdominal trauma. *Surgeon*. 2013; 2: 51-60.
- [2] Bagenko S.F., Kashansky S.F., Rzaev R.S., Kucheev I.O. Anatomical substantiation of the method of treatment of pelvic injuries with a violation of the integrity of its ring // *Travmatologiya i ortopediya Rossii*. – 2009. – No 2 (52). pp. 46–52.
- [3] Bisenkov L. N., Zubarev P. N., Trofimov V. M., Shalaev S. A., Ishchenko B. And. Emergency surgery of the chest and abdomen. 2nd ed., overwork. and addendum. Gippokrat, 2006.
- [4] Bondarenko A.V., Gerasimova O.A., Lukyanov V.V., Timofeev V.V., Kruglykhin I.V., Composition, structure of injuries, lethality and features of assistance in victims at the stages of treatment of polytrauma. Organization of Specialized Medical Care No. 1 [March] 2014, pp. 15-28.
- [5] Costa G., Tomassini F.; Tierno S.M. et al. The prognostic significance of thoracic and abdominal trauma in severe trauma patients (Injury severity score > 15). *Ann ItalChir* 2010; 81 (3): 171-176.
- [6] Dyusupov A.A., Bukatov A.K., Bazarbekov E.N., Serikbayev A.S., Manarbekov E.M., Dyusupova B.B. Minimally invasive osteosynthesis of damage to the musculoskeletal system in polytrauma. New medical technologies. No 2 June, Kazakhstan. 2018, No 2. S.27-34.
- [7] Ergashev O.N., Goncharov A.V., Pryadko A.S., Vinogradov Yu.M. Liver damage in victims with severe combined trauma. *Bulletin of Surgery*. 2011. № 6. S. 52-55.
- [8] Fabian TC, Croce MA. Abdominal trauma, including indications for celiotomy. In: Mattox KL, Feliciano DV, Moore EE, eds. *Trauma*. 4 ed. New York: McGraw-Hill Companies. 2000:583-602.
- [9] Gumanenko E.K., Samokhvalov I.M. Military field surgery of local wars and armed conflicts. M.: GEOTAR Media, 2011, 672 p.
- [10] Gumanenko E.K., Khromov A.A., Linnik S.A., Nazarov Kh.N., Chapurin V.A., Kucheev I.O., Tashev A.A. New directions in the treatment of fractures of the bones of the upper extremities in victims with severe multiple and combined injuries. *Surgery of injuries "Bulletin of Surgery"* 2016, p.46-51.
- [11] Indiaminov S. I., Kim A. A. Epidemiological aspects and a current approach to the problem of carbon monoxide poisoning // *Russian Journal of Forensic Medicine*. – 2020. – T. 6. – №. 4. – C. 4-9.
- [12] Indiaminovich I. S., Amurovna K. A. TANATOGENETIC VALUE OF INDICATORS OF CONCENTRATION OF CARBOXYHEMOGLOBIN IN BLOOD IN COBON GAS POISONING // *BBK 79*. – 2020. – C. 72.
- [13] Indiaminov S. I., Kim A. A. Damage to the structures of the brain in acute carbon monoxide poisoning // *Sudebno-meditsinskaia Ekspertiza*. – 2021. – T. 64. – №. 4. – C. 17-21.
- [14] Indiaminov S. I., Kim A. A. Morphology of the Brain Structure in Acute Carbon Monoxide Poisoning // *American Journal of Medicine and Medical Sciences*. – 2020. – №. 10. – C. 10.
- [15] Indiaminov S. I., Kim A. A. Damage to the structures of the brain in acute carbon monoxide poisoning // *Sudebno-meditsinskaia Ekspertiza*. – 2021. – T. 64. – №. 4. – C. 17-21.
- [16] Katsoulis E., Tzioupis C., Sparks I., Giannoudis P.V. Compressive blunt trauma of the abdomen and pelvis associated with abdominal aortic rupture // *ActaOrthop. Belg*. – 2006. – Vol. 72, N 4. – P. 492–501.
- [17] Khadzhibayev A.M., Shukurov B.I., Atajanov Sh.K., Khakimov A.T. Possibilities of videoendosurgery for closed injuries of the abdominal organs in victims with combined trauma. *Emergency medicine bulletin* 2020; 4: pp. 23–26.
- [18] Kim A. A., Indiaminov S. I., Usarov A. Zh. Medical and social aspects of carbon monoxide poisoning // *Journal of Biomedicine and Practice*. – 2020. – №. 3. – C. 85-92.
- [19] Kucukdurmaz F., Alijanipour P. Current concepts in orthopedic management of multiple trauma // *Open Orthop. J*. 2015. Vol. 31, No 7. P. 275–282.
- [20] Menyar A, Abdelrahman H, Al-Thani H, Zarour A, Parchani A, Peralta R, Latifi R. Compartmental anatomical classification of traumatic abdominal injuries from the academic point of view and its potential clinical implication. *J Trauma Manag Outcomes*. 2014; 8: 14. <https://doi.org/10.1186/1752-2897-8-14> e Collection 2014.
- [21] Pfeifer R., Teuben M., Andruszkow H. et al. Mortality Patterns in Patients with Multiple Trauma: A Systematic Review of Autopsy Studies // *PLoS One*. – 2016. - № 11(2).
- [22] Potapov A.A., Likhterman L.B., A.D. Kravchuk, V.N. Kornienko, N.E. Zakharova, A.V. Oshorov, M.M. Filatova Modern approaches to the study and treatment of traumatic brain injury. *Clinical Neurology Volume 4. No 1, 2010, p.4-12.*
- [23] Shapkin Yu.G., Seliverstov P.A., Efimov E.V., Surgical

- tactics for polytrauma with injuries of the musculoskeletal system. *Polytrauma*. No4, 2014, p. 62-68.
- [24] Sharipov I.A. Chest trauma: problems and solutions. *Grail* 2003; p. 328.
- [25] Sirozhov K.Kh., Karimov K.K., Akhmedov Sh.M., Ashurov B.O. Structure of combined skeletal trauma in the Republic of Tajikistan. *Practical medicine. Surgery, oncology*. 2 (67), May 2013, p.165-168.
- [26] Sokolov V.A. Multiple and combined injuries / V.A. Sokolov. – M.: GEOTAR-Media, 2006. – 512 p.
- [27] Totterman A., Madsen J.E., Skada N.O., Roise O. Extraperitoneal pelvic packing: a salvage procedure to control massive traumatic pelvic hemorrhage // *J. Trauma Injury Infect. Crit. Care*. – 2007. – Vol. 62, N 4. – P. 843–852.
- [28] Tulupov A.N. Combined mechanical trauma: a guide for doctors / SPb.: 2012.393 s.
- [29] Urman M.G., Subbotin A.V. Surgical tactics for liver injury and developed intra-abdominal complications. *Bulletin of Surgery*. 2009. №3. p.72-75.