

UDC 616–001.514:616–09–03+ 330.131.7

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Clinical effective risks of mortality in road traffic injury victims depending on the severity of damage

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Paediatric Surgery(Ukraine).2024.1(82):57-61; doi 10.15574/PS.2024.82.57

For citation: Guryev SO, Kushnir VA, Solovyov OS. (2024). Clinical effective risks of mortality in road traffic injury victims depending on the severity of damage. Paediatric Surgery (Ukraine). 1(82): 57-61; doi: 10.15574/PS.2024.82.57.

Road traffic accidents cause significant trauma to the population and are one of the main causes of mortality in working age. The novelty of the study risk-oriented patterns of severity of damage and mortality of victims of road accidents have been established.

The **aim** – to create of a fundamental basis for the formation of clinical routes and protocols for victims of road accidents by establishing and verification the relationship between the severity of damage and the death of the victims.

Material and methods. An analysis of 1,696 cases of road traffic injuries was carried out, and the standardized New Injury Severity Score (NISS) assessment system was used.

Results. A probable, but indirect dependence of the clinical effective risk of a negative outcome of the traumatic process in victims on the severity of the damage was established. It was established that the sign of participation in the traffic the formation of clinical effective risks of a negative outcome of the traumatic process, starting with the severity of damage according to the NISS with 25 points. With the same qualitative characteristics, pedestrians have the highest risk of fatality, drivers have the lowest risk. The synergistic effect of the severity of damage and the clinical and anatomical form of the injury was established.

Conclusions. The risk of a fatal outcome of a road traffic injury in general directly depends on the severity of damage to the victim, although the dependence is not direct. The clinical and anatomical form of damage together with the severity of the damage have a synergistic effect on the formation of the clinically effective risk of mortality in victims of a road traffic accident, and the predominant influence is the clinical and anatomical form of damage.

No conflict of interests was declared by the authors.

Keywords: risks, mortality, traffic injury, severity of damage.

Клінічні результативні ризики летальності в постраждалих із дорожньо-транспортною травмою залежно від тяжкості пошкодження

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Дорожньо-транспортні пригоди (ДТП) викликають значне травмування населення та є однією з основних причин смертності в працездатному віці. Новизна дослідження полягає в тому, що вперше встановлено ризикорієнтовані закономірності тяжкості пошкодження та смертності постраждалих унаслідок ДТП.

Мета – створити фундаментальну основу для формування клінічних маршрутів і протоколів постраждалих унаслідок ДТП шляхом встановлення й верифікації зв'язку тяжкості пошкодження та смерті постраждалого.

Матеріали та методи. Проаналізовано 1696 випадків дорожньо-транспортного травматизму та використано стандартизовану систему оцінювання New Injury Severity Score (NISS).

Результати. Встановлено вірогідну, але опосередковану залежність клініко-результативного ризику негативного результату перебігу травматичного процесу в постраждалих унаслідок ДТП від тяжкості пошкодження. Виявлено, що ознака участі в русі впливає на формування клініко-дієвих ризиків виникнення негативного результату перебігу травматичного процесу в постраждалих, починаючи з тяжкості ушкодження за NISS з 25 балів. При однакових якісних характеристиках найвищий ризик загибелі мають пішоходи, найнижчий – водії. Відзначено синергійний ефект тяжкості ушкодження та клініко-анатомічної форми ушкодження. Усі результати вірогідні за критеріями та вимогами доказової медицини.

Original articles. Orthopedics

Висновки. Ризик летального наслідку дорожньо-транспортної травми в цілому безпосередньо залежить від тяжкості ушкодження потерпілого, хоча залежність не є прямою. Ризик негативного результату перебігу травматичного процесу в постраждалих унаслідок ДТП безпосередньо залежить від ознаки участі в дорожньому русі. Найвищий кількісний показник ризику загибелі внаслідок ДТП мають пішоходи з однаковою якісною ознакою характеристики клінічного результативного ризику, у водіїв показник ризику найменший. Клініко-анатомічна форма пошкодження разом із тяжкістю пошкодження мають синергетичний вплив на формування клініко-результативного ризику загибелі постраждалих у ДТП, причому переважний вплив має клініко-анатомічна форма пошкодження.

Автори заявляють про відсутність конфлікту інтересів.

Ключові слова: світові ризики, смертність, дорожньо-транспортна травма, тяжкість пошкодження.

Introduction

Road traffic injury remains one of the most important causes of death of the population almost all over the world. Unfortunately, there has been no steady trend of decreasing mortality and lethality due to traffic accidents in recent years. An important component of solving this problem is establishing the relationship between the lethality of the victims and the clinical signs of damage. Taking into account the variety of clinical signs of road traffic injury to describe the clinical characteristics, the method of standardization using standardized rating systems (scales) is used. We authors considered it expedient to determine the dependence of the victim's mortality risk on the results of a standardized clinical assessment.

The aim of the research – to establish the presence and nature of the dependence of lethality (a negative outcome of the course of the traumatic process) of victims of road traffic injuries on the severity of damage based on a risk-oriented assessment.

Materials and methods of the study

The array of the study was 1,696 cases of road traffic injuries in victims of road traffic accidents. The formation of the research array took place in the order of an epidemiological experiment on real-life models (a metropolis, a rural area, a regional city). The models were formed on the basis of actually existing administrative and territorial entities of Ukraine in accordance with the requirements of the Law of large numbers. The victims were injured in the period 2018–2020. Standardization of the clinical characteristics of the injury was

carried out using the New Injury Severity Score (NISS) standardized assessment system. A standardized scoring system is recommended for road traffic injury victims [3]. At the same time, the following gradations of damage severity were established in each anatomical and functional area from 1 to 4 points in ascending order of damage severity, total score from up to 16 points (minor damage), 16–24 points (light damage), 25–34 points (moderate severity damage), 35–44 points (severe damage), 45–75 points (extremely severe damage and agonizing Clinical outcome risks were defined as the ratio of the probability of death and recovery of victims. The analysis was carried out with the help of computer technologies. All obtained results meet the criteria and requirements of evidence-based medicine.

Results of the study

The analysis of the distribution of the study array based on the indicator of the standardized NISS assessment system allowed us to obtain the following results (Table 1). The analysis of the distribution of the study array according to the severity of the damage is given in Table 1.

Set out in Table 1, the data allow us to state that there is a clear tendency to increase the indicator of the clinical effective risk of a negative outcome of the course of the traumatic process as the indicator of the severity of the damage increases. Moreover, fluctuations in risk indicators are large, from theoretically impossible to cata-

Table 1

Analysis and evaluation of clinical effective risks according to the risk factor «severity of damage»

The NISS index, points*	Quantitative risk characteristics	Qualitative risk characteristics	Rank
Minor damage, up to 16	0.001	theoretically impossible	5
Light damage, 16–24	0.06	minimal	4
Moderate severity damage, 25–34	0.47	significant	3
Severe, damage 35–44	0.83	catastrophic	2
Extremely severe damage and agonizing, 45–75	1.59	catastrophic	1

Note: * – in total for all anatomical and functional areas.

Table 2

Integral analysis and evaluation of clinical effective risks according to the risk factor «severity of damage» in groups of traffic participants

NISS index, points*	Drivers		Passangers		Pedestrians	
	quantitative risk characteristics	rank	quantitative risk characteristics	rank	quantitative risk characteristics	rank
Up to 16	0	5	0	5	0.003	5
Light, 16–24	0.03	4	0.06	4	0.07	4
Moderate severity, 25–34	0.20	3	0.32	3	0.88	2
Severe, 35–44	0.75	2	1.13	2	0.67	3
Extremely severe and agonizing, 45–75	1.11	1	1.50	1	1.82	1

Note: * – in total for all anatomical and functional areas.

strophic. There are two rather sharp periods of the transition of the quantitative risk indicator: from a light degree of damage to moderate severity, where the risk indicator increases from minimal to significant damage with moderate severity, and also during the transition from moderate severity to severe injury, where the risk increases from significant to catastrophic, that is, the growth trend of the risk indicator according to the damage severity indicator has a discrete character. At the same time, the ratio of the maximum and minimum risk indicators is 1.59, which indicates a very high level of distribution dissipation.

In order to determine the clinical effective risk from the severity of damage in groups of victims participating in the traffic, we conducted an integral analysis of such risk in groups of participants in the traffic. The data of this analysis are given in Table 2.

Data analysis of Table 2 allows us to define the following:

- the lowest indicators of clinical effective risks based on the severity of damage are generally observed in drivers.
- the highest indicators of risks based on the severity of damage are generally observed in pedestrians.

In victims with a severity of damage up to 16 points, the indicators of clinical effective risk are within the limits of theoretically impossible in all traffic participants. In victims with mild injuries (16–24 points), the indicator of clinical effective risk is within the minimum range for all traffic participants. In the case of injuries of moderate severity (25–34 point), the indicator of clinical effective risk ranges from insignificant for drivers to catastrophic for pedestrians. In case of severe damage to the victims (35–44 points), the indicator of clinical effective risk is catastrophic for passengers and critical for drivers and pedestrians.

It is important from a scientific and practical point of view to determine the influence of the clinical and anatomical signs of the form of damage and the severity of

the damage on the formation of a clinically effective risk of a negative outcome of the course of the traumatic process in victims of road traffic trauma (Table 3).

As a result of the analysis of the above data, the following patterns can be established:

1) with minor damage to all clinical and anatomical areas, the qualitative characteristic of the indicator of clinical effective risk is minimal, but in terms of quantitative value, this indicator is the highest for abdominal damage (0.09) and is as close as possible to the qualitative characteristic of insignificant risk;

2) with extremely severe injuries of victims, the qualitative characteristic of the clinical effective risk is catastrophic, except for victims with pelvic injuries, where such an indicator is critical. According to the quantitative characteristic, the clinical effective risk is the highest in the group of 25 points with cranial injuries. The probable influence of the clinical and anatomical feature on the formation of the clinical effective risk is observed in the group of victims, starting with 4 points (light damage).

It is also worth noting that the influence of the standardized indicator of the severity of damage on the formation of clinical effective risk is not the same for each clinical and anatomical form of damage in traffic accident victims. It was established that the ratio of the maximum to the minimum indicators in the clinical-anatomical group for and neck injuries is 2.24, for spine damage – 1.17, for chest damage – 2.42, for abdominal damage – 2.20, for pelvic damage – 2.07, with damage to the limbs – 1.57. Thus, the standardized indicator of the severity of damage has the greatest influence on the formation of the risk indicator in victims with head and neck injuries 2.24, and the smallest impact was recorded in the case of chest injuries – 2.42. That is, in victims with such clinical and anatomical forms of damage, such as the abdomen, pelvis, spine and chest, the clinical and anatomical sign of damage when forming an indicator of the clinical effective risk of the occurrence of a nega-

Table 3

Integral analysis and evaluation of clinical effective risks according to the risk factors «clinical and anatomical form» and «severity of damage»

Anatomical and functional area	1 point* (minor damage)	4 points* (light damage)	9 points* (moderate damage)	16 points* (severe damage)	25 points* (extremely severe damage)
Head	0.01	0.05	0.02	0.33	2.13
Spine	0.05	0.12	0.03	0.08	0.89
Chest	0.06	0.11	0.32	0.68	1.25
Abdomen	0.09	0.17	0.43	0.51	1.00
Pelvis	0.04	0.09	0.08	0.51	1.25
Limbs	0.02	0.04	0.17	0.24	1.25

Note: * – for each anatomic-functional area separately.

tive result of the course of the traumatic process in victims with a road traffic injury has a greater weight according to the indicator of severity of damage.

Discussion of the research results

As a result of the conducted research on the dependence of lethality (negative outcome of the course of the traumatic process) of victims of road traffic injuries on the severity of damage based on a risk-based assessment, it was established that there is a pronounced and probable dependence of the clinical outcome risk of the occurrence of a negative outcome of the course of the traumatic process in victims of road traffic injuries from the severity of the damage. In general, this fact is not new in the scientific and clinical sense, this trend was noted by many scientists [5,7–9,17]. However, a risk-oriented approach was not applied, which is an original feature of this study.

As a result of the conducted research, it was established that the sign of participation in traffic affects the formation of clinical effective risks of the occurrence of a negative outcome of the course of the traumatic process in the victims, starting with the severity of damage according to the NISS with 25 points. Such results are original and new in the scientific and clinical sense. Although separate studies of the impact of signs of participation of victims in traffic were previously conducted, they were sporadic in nature and no comparison of different traffic participants was conducted [2,4,7,8,13]. A clinical outcome risk analysis was also not applied.

It has been established that a high rate of clinical effective risk in passengers with severe injuries occurs as a result of a delay in the provision of medical assistance due to limited access to the injured vehicle during deformation of the vehicle frame and less use of seat belts by passengers, which leads to additional injuries. This correlates with the data of domestic and foreign scientists [10–12,14]. It is quite interesting that the dependence of

the indicators of clinical effective risks on the sign of participation in traffic occurs only starting with injuries of medium severity. Such data are new and original.

As a result of the conducted research, it can be concluded that there is a synergy between the clinical and anatomical form of damage and the severity of the damage in the formation of a clinically effective risk of a negative outcome of the course of the traumatic process in the victims. However, it is worth noting that the clinical and anatomical form of the injury is of primary importance. Such data generally correlate with the results of research by foreign scientists [6,15,16,18], and clarify such results using a risk-oriented approach.

Thus, this small study makes a certain contribution to solving the problem of combating mortality and lethality due to traffic accidents.

Conclusions

The risk of a fatal road traffic injury in general directly depends on the severity of damage to the victim, although the dependence is not direct.

The risk of a negative result of the course of the traumatic process in victims of road traffic injuries directly depends on the sign of participation in traffic.

Pedestrians have the highest risk of mortality as a result of a traffic accident with the same qualitative characteristics of the clinical outcome risk, drivers have the lowest.

The clinical and anatomical form of damage together with the severity of the damage have a synergistic effect on the formation of the clinical effective risk of mortality in victims of a road traffic accident, and the clinical and anatomical form of damage has a predominant influence.

No conflict of interests was declared by the authors.

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Стаття надійшла до редакції 09.12.2023 р., прийнята до друку 12.03.2024 р.