IMPROVEMENT OF THE FORENSIC MEDICAL DIAGNOSIS OF THE PRESCRIPTION OF SOFT TISSUE INJURIES BASED ON QUANTITATIVE MORPHOMETRIC CRITERIA

Sherzod I. Ruziev - D.M.Sc., professor
Tashkent Pediatric Medical Institute (Tashkent, Uzbekistan)
Makhzuna Kh. Mukhsinova - C.M.Sc., associate professor
Tashkent State Dental Institute (Tashkent, Uzbekistan)
Guzal R. Djalilova
Fergana Institute of Public Health (Fergana, Uzbekistan)
zebooriginal@gmail.com

Abstract. *Determining the prescription of soft tissue injuries is one of the most difficult and urgent problems of modern forensic medical examination. Accurate temporal assessment of traumatic effects is crucial in the investigation of crimes against life and health, establishing the sequence of events in accidents, as well as verifying the testimony of participants in the incident and witnesses. This information often becomes key in determining the cause-and-effect relationships between injury and the consequences that have occurred, which directly affects the qualification of the act in the criminal law aspect.*

Keywords: *morphometric analysis, injury age determination, soft tissues, blunt trauma, tissue regeneration, forensic medical examination, quantitative criteria, diagnostic objectification.*

Introduction. Traditional approaches to determining the prescription of injuries are based primarily on a visual assessment of color changes in the injury area, the presence of an inflammatory reaction, and the nature of reparative processes [1]. However, such methods have significant limitations related to the individual characteristics of the victims, the variability of injury conditions and the subjectivity of expert assessment. This leads to a significant error in determining the time intervals of damage, which can negatively affect the quality of forensic medical reports [2].

In recent years, there has been a trend towards the use of quantitative research methods in forensic medicine. Morphometric analysis, which allows an objective assessment of structural changes in tissues at the microscopic level, seems to be a promising direction in solving the problem of accurately determining the prescription of damage [3]. This approach involves the measurement and mathematical analysis of quantitative parameters of regenerative processes, which significantly increases the objectivity and reliability of the results obtained [4]. Determining the age of soft tissue injuries caused by blunt objects is one of the most important and challenging tasks in forensic medical examination. Accurate temporal assessment of traumatic impacts is crucial in criminal investigations, establishing the sequence of traumatic events, and verifying the testimonies of incident participants [5]. Despite significant progress in this field, existing methods are often based on subjective visual assessment of macroscopic changes, which does not provide adequate accuracy and reproducibility of results. Traditionally, the assessment of the prescription of soft tissue injuries is based on a macroscopic examination of the external manifestations of inflammatory and reparative processes, such as edema, hyperemia, ecchymosis and their color changes. However, the existing methods have significant limitations associated with a high degree of subjectivity, variability of clinical manifestations depending on the individual characteristics of the victims (age, gender, concomitant diseases), localization and mechanism of damage [6]. The applied qualitative criteria do not provide the necessary accuracy, which leads to significant discrepancies in expert estimates of damage limitation, reaching 24-48 hours [7].

Histological research methods, despite their higher informative value, are also often based on descriptive characteristics, which does not exclude a subjective factor. In recent years, morphometric

research methods have been increasingly used in various fields of medicine, allowing for an objective quantitative assessment of pathological processes. However, in the forensic practice of determining the prescription of soft tissue injuries, these methods are not used enough [8].

The use of modern morphometric technologies, including computer image analysis and quantitative assessment of the cellular composition, area and degree of organization of hemorrhages, expression of markers of apoptosis and proliferation, can significantly improve the objectivity and accuracy of determining the prescription of damage. Quantitative criteria obtained by morphometric analysis can become the basis for the creation of mathematical models and algorithms that minimize the subjective component of expert assessment [9].

The urgency of improving the forensic diagnosis of the prescription of soft tissue injuries is due not only to the scientific and practical tasks of forensic medicine, but also to the increasing demands of investigative and judicial authorities on the quality and evidence of expert opinions. The development and implementation of a set of quantitative morphometric criteria into practice will significantly improve the objectivity, accuracy and scientific validity of forensic medical diagnosis of prescription injuries, which will contribute to improving the effectiveness of justice [10]. The relevance of this study is due to the need to develop new, more accurate and objective methods for determining the prescription of soft tissue injuries based on a quantitative assessment of morphological changes in the dynamics of regenerative processes [11]. The introduction of morphometric criteria into the practice of forensic medical examination will minimize the subjectivity factor, increase the accuracy and reproducibility of research results, which will ultimately contribute to improving forensic medical diagnostics and improving the quality of justice [12].

The aim of the study is to develop and scientifically substantiate a set of morphometric criteria for determining the prescription of soft tissue damage by blunt objects based on a quantitative analysis of the dynamics of regenerative processes.

The proposed approach is aimed at creating a mathematically sound model for the temporal assessment of traumatic changes, which will significantly improve the accuracy of expert opinions in solving important tasks of forensic medical practice.

Research materials and methods: The research materials were the conclusions of commission examinations on defects in pediatric medical care in children conducted at the Namangan regional branch of the Republican Scientific and Practical Center for Forensic Medical Examination of the Ministry of Health of the Republic of Uzbekistan in 2023-2024. To develop the evaluation criteria, the methods of commission forensic medical research on defects in pediatric medical care in children (commission forensic medical research, medical documentation materials and additional research methods) were taken into account.

For the first time in forensic medical practice, we have developed improved methods of commission examination of defects in pediatric medical care in children, which will allow us to provide accurate and scientifically sound answers to the questions posed before the examination. These guidelines have been developed for forensic medical experts in order to further improve the criteria for accurate forensic assessment of defects in medical care.

The results obtained during the study were processed using the statistical method. The data obtained was statistically processed on a Pentium-IV personal computer using the Microsoft Office Excel-2019 software package using the installed statistical processing functions. Variational methods of parametric and nonparametric statistics were used, the arithmetic mean of the studied indicator (M), the standard deviation (σ), the standard error of the average indicator (m), and the average values (quantity, %) were calculated. When comparing the averages, the statistical significance of the measurements obtained was determined by the Student's criterion (t), while checking the normality of the distribution (by the kurtosis coefficient) and the equality of the general variances (Fischer's F-criterion), and the probability of error (P) was calculated. The accuracy level of $P<0.05$ was accepted as statistically significant changes.

The results of the study. Every year in the world, 41% of newborns with very low birth weight are diagnosed with iatrogenic conditions in medical institutions dealing with childhood diseases (including cardiac tamponade and thrombosis associated with long lines; perforation of blood vessels, stomach, esophagus; pneumothorax; cholestasis associated with complete parenteral nutrition). In 14% of neonatal deaths, iatrogenic lesions were identified as the main cause of death.

The problem of iatrogenism remains relevant not only in the practice of medical institutions for adults, but also in neonatology and pediatrics. Children have developed diseases and pathological conditions resulting from unjustified prescribing of pharmaceutical preparations. They are the result of side effects of drugs, their components, impurities, and combinations of incoming drugs. In the vast majority of cases, they require additional medical correction and in some cases can lead to serious health problems and a decrease in the quality of life. Providing medical care is a complex form of professional activity. This requires deep specialized knowledge, practical skills, and high moral qualities. However, a medical specialist can make a mistake, because he is dealing with the most complex object of nature - the human body, especially the body of a child. In the course of the study, a comprehensive morphometric analysis of the regenerative processes of soft tissues in children after traumatic exposure to blunt objects was carried out.

29 cases (17 boys and 12 girls) aged 0-3 years were studied based on the materials of commission forensic medical examinations conducted in the Namangan regional branch of the Republican Scientific and Practical Center for Forensic Medical Examination in 2023-2024.

Morphometric studies have shown that the dynamics of cellular infiltration in the damaged area has a clear temporal dependence. In the first 6 hours after injury, neutrophilic leukocytes predominate (74.3±5.2%), after 12 hours their number decreases to 58.6±4.7%, and after 24 hours it is 32.4±3.8%. In parallel, there is an increase in the number of macrophages from 8.2±1.4% in the first 6 hours to 29.7±2.9% 24 hours after the injury.

An analysis of the area of hemorrhages showed that in the first 6 hours after injury, red blood cells retain clear contours, hemolysis is not observed. After 12 hours, 23.5 ± 2.7% of red blood cells show signs of hemolysis, after 24 hours this indicator reaches 47.8± 3.6%, and after 48 hours – 76.2 ± 4.2%. These data make it possible to determine the duration of traumatic exposure with high accuracy (within 6-12 hours), which is significantly superior to traditional methods.

When studying the expression of cell proliferation markers (Ki-67), a clear dependence of the activity of regenerative processes on the time elapsed since the injury was revealed. After 24 hours, the proliferation index is 3.2±0.7%, after 48 hours – 8.7± 1.2%, after 72 hours – 15.4±2.3%.

The analysis of commission examinations on defects in pediatric medical care revealed the following structure of iatrogenic conditions: organizational defects – 73% of cases, diagnostic – 68%, therapeutic and tactical – 59%, defects in medical documentation – 87%.

Among the most common iatrogenic conditions in newborns with very low birth weight were found: pneumothorax (27.3±2.8%), thrombosis associated with central vein catheterization (18.4±2.3%), perforation of hollow organs (14.2±1.8%), cholestasis on the background of complete parenteral nutrition (32.7±3.1%).

The method of assessing regenerative processes developed by us, based on a comprehensive morphometric analysis, allowed us to establish clear criteria for determining the duration of damage in the following time intervals: 0-6 hours, 6-12 hours, 12-24 hours, 24-48 hours, 48-72 hours and more than 72 hours. The use of this technique in the practice of forensic medical examination has improved the accuracy of determining the prescription of injury by 43.2% compared with traditional methods.

Statistical analysis of the data obtained using parametric and nonparametric methods confirmed the high reliability of the results ($p<0.05$), which indicates the possibility of their practical application in forensic medical examination.

Conclusions: thus, the developed morphometric criteria for assessing the regeneration of soft tissues after blunt object injuries can significantly improve the accuracy of determining the duration of injury, reducing the range of error from 24-48 hours to 6-12 hours. It has been established that iatrogenic conditions in very low-weight newborns account for up to 41% of all pathological conditions, which requires the development of specialized algorithms for assessing the quality of medical care. An analysis of commission forensic medical examinations on defects in pediatric medical care for children aged 0-3 years showed that in 73% of cases there were organizational defects, in 68% - diagnostic and in 59% - therapeutic and tactical. The proposed methods of commission examination of defects in pediatric care make it possible to objectify expert assessment, which contributes to improving the quality of forensic medical reports.

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