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Forensic Medical Criteria and Patterns of Liver Injuries from Blunt Trauma

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Abstract Liver damage is one of the serious medical issues arising from closed trauma caused by blunt objects. This situation is frequently observed in the practice of traumatology and forensic medicine, as it can result from traffic accidents, falls, and occupational injuries. The liver, as one of the key organs, plays a critical role in metabolism and filtering toxins, and its damage can lead to serious consequences for the body, including internal bleeding and shock. The study of the morphological characteristics of liver injuries and their patterns in closed trauma by blunt objects is of significant importance for diagnosis and treatment.

Keywords Liver damage, Closed trauma, Blunt objects, Morphological characteristics

1. Introduction

Abdominal closed injuries are considered one of the most complex issues of modern Traumatology and forensic examination. Such lesions often lead to varying degrees of impaired liver function, which can have serious consequences for the patient's vital activity and prognosis [1]. According to statistics, closed abdominal trauma accounts for 15-20% of total traumatic injuries. In this case, liver damage is observed in 40-60% of cases and is characterized by high mortality rates. In forensic practice, the correct assessment of such cases is of particular importance, since the need to accurately determine the degree of impairment of liver function, the complexity of establishing a causal link between injury and death, the inadequacy of the existing diagnostic criteria. Blunt-force trauma remains one of the most common types of trauma and often leads to death. In the forensic examination of fatal blunt injuries of the chest and abdomen, the question is often asked about the mechanism of injury: as a result of shock and compression injuries, etc. For this, the morphology of damage to the internal organs of the chest and abdomen is used [2].

The liver is often injured because it is located close to the surface of the body and has large dimensions. To solve expert questions, the study of its lesion morphology seems promising [3]. However, according to many experts, liver lesions do not provide information, and their morphological characteristics are determined only by the degree of distribution, a characteristic that depends on the storage of the capsule [4]. Other experts believe that the morphology of liver injuries allows forensic diagnostics of the injury mechanism. Signs of diagnostic value at the time of a blunt liver injury include subcapsular blood clots and subcapsular cracks, cracks and discontinuities of the capsule and parenchyma of organs, crush foci and central discontinuities, marginal tissue separation, connective tissue and gallbladder lesions [5].

Among the lesions shown, the highest polymorphism has organ breaks. The main reason for the formation of liver lesions at the time of injury with blunt objects is tissue elongation. Elongation is produced by the development of compression, sliding and stretching processes, which are caused by local and general deformation of the liver, including organ displacement.

Deformation develops as a result of external traumatic impact [6], variants of which can be punches, legs, moving vehicle detail blows given by different forces, impact on different objects in a fall, etc [7].

In different types of external influences, different degrees of local and general deformation of the liver are observed, and different expressions of the processes of destruction, which affect the polymorphism of its junctions: their different number, different orientation, localization, shape and dimensions. However, a holistic vision based on a comprehensive assessment of the laws of formation of liver lesions does not exist at the moment. Liver damage is one of the most common and dangerous types of abdominal trauma. Due to its anatomical location and physiological characteristics, the liver is the first to be damaged in blows with blunt objects. The correct interpretation of the morphological features of liver lesions in the practice of forensic examination is important for determining the mechanism of injury and substantiating expert conclusions [8].

Currently, the morphological description of liver lesions and the mechanisms of their formation have not been fully studied. While the general classification and clinical aspects

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of liver trauma have been extensively covered in the existing literature, the specific morphological signs of lesions produced by various traumatic effects have not been adequately analyzed. According to statistics, liver damage occurs in 40-60% of cases in closed abdominal trauma [9].

The study of the morphology of internal organ damage during injury with blunt objects is an urgent problem of Forensic Medicine. The variety of lesions shown, various approaches to the description of their morphology due to the use of clinical classifications, as well as a lack of knowledge about the laws of formation of lesions in different types of external influences , explains the absence of scientifically based diagnostic criteria for forensic diagnostics of injury cases with blunt objects in accordance with the nature of damage to internal organs. It seems promising to study the laws of the formation of lesions at the time of injury with blunt objects in the same tissues or organs. It is possible to introduce the liver into such organs [10]. This organ is often injured because it has large dimensions and is located close to the body surface. Therefore, the study of liver damage during an injury with blunt objects is also an urgent task. Compression of the body leads to a gross injury to the organ, and leads to the formation of one or more subcapsular blood clots in the anterior and posterior parts of the liver - where the scarring force is affected, and at the opposite pole. In addition, wide central junctions, sometimes with the liver completely divided into two parts, elongated flexible peripheral junctions with uneven and crumbly margins, capsule separations are formed, which are surrounded by gaps containing blood, blood clots in the liver ligaments. Frontal compression of the body causes the liver to shift and flatten, causing its overall deformation [11]: in the direction of compression, the liver is compressed, the longitudinal size ("diameter") decreases, and the transverse dimensions of the liver increase. Deformation leads to the displacement (sliding) of the inner layers of the liver tissue in opposite directions and the formation of a large number of cracks in its greatest stretching areas, which are observed in the central and peripheral parts of the liver. Compression of the liver leads to its twisting along the "equator" and the formation of long lesions - complete interruptions, often along the sickle-like ligament. The lower force of body compression usually leads to less pronounced lesions in the form of subcapsular blood clots [12].

Frontal compression of the body with great force (for example, when staying under a car wheel) causes the liver to press on the spine and bend through it, and a wide junction is formed, located in the sagittal plane, until almost complete separation of the organ . Also, when staying under the car wheel, a displacement of the compression furnace occurs in the direction of movement, which leads to the formation of parallel slits, arc-shaped, with the convex part oriented towards the side of movement. Frontal compression with great force among massive objects leads to compression of the liver between the ribs and spine, and disruption of the right segment of the liver, interruptions of the left segment. The direction of the junctions coincides with the direction of compression. Blood clots form under the capsule and deep in the liver. The major internal hepatic bile ducts and blood vessels, the inferior intravascular wall, are severed [13]. Histological examination of liver tissue reveals foci of "indirect" blood transfusion under the small capsule. Visually, such foci are undetectable because they are caused by the propagation of a hydrodynamic wave along the veins (long lesions). The displacement of the liver caused by compression of the body leads to the formation of foci of blood clots in the parenchyma, subcapsular blood clots at the junctions of the ligaments, junctions of the ligaments. Thus, frontal compression of the body leads to rough scarring of the liver and the formation of several foci of injury [14]. Using common signs of liver damage, their number, anatomical localization, orientation, dimensions, shape, in some cases it is possible to distinguish between traumatic and compressive trauma. At the same time, additional injuries to the chest and abdomen will help in solving this issue.

The forensic literature presents conflicting accounts of liver lesions characteristic of body vibration [15]. Generating an idea of organ lesions in this type of external influence is possible through a comparative morphological analysis of lesions in different types of external influences, in which there is organ vibration. The most informative in this respect is the trauma of falling from a height. In order to fall from a height, it is characteristic of large sub-capsule blood transfusions and the formation of a large number of interruptions in two sections of the liver. Interruptions are mainly located on the diaphragm surface of the organ, have a small depth (in the type of cracks), have a different orientation (most often in the sagittal direction). The formation of discontinuities is due to the general deformation of the organ.

To fall from a large height, large deserinated foci are typical in different parts of the liver, liver tissue lesions in the area of gallbladder laying, obstruction of the central parts of the liver, liver lesions of the gallbladder. To fall on the head, the formation of subcapsular hematomas for liver lesions is not characteristic when the vibration of the body is the main cause of injury, the liver ligaments are not damaged due to the fixation of the liver by the diaphragm.

In coarse scarring of the liver, discontinuities are formed on both surfaces. In conditions where there is no direct trauma to the organ, the liver is additionally injured (in addition to excessive stretching of the ligaments) from hitting the diaphragm, ribs and spine.

When falling on the leg or buttocks, in cases of falling from a large height to the head or leg, organ ligament injuries are observed, without directly affecting the liver Area.

When falling from a height and hitting a hard surface with the liver area, lesions of surrounding tissues and organs are formed (retroperitoneal and kidney circumference in adipose tissue, right Dome of the diaphragm, massive blood clots along the spine, kidneys, lungs, spleen, pancreas interruptions, broken ribs).

For intra-car trauma, a general shock vibration of the body is characteristic, in which a large number of liver interruptions are detected.

Consequently, liver lesions typical of the general shock oscillation of the body are lesions caused by its sharp displacement - opposite shock lesions, lesions in the area of the organ-fixing apparatus: blood clots in the area of the liver Gates, blood clots in the places of attachment of the ligaments and tissue interruptions. In addition, superficial (in the type of cracks) and central discontinuities are formed.

2. Conclusions

Thus, shock, compression trauma, as well as trauma from the general shock vibration of the body are characterized by the formation of local and long lesions of the liver, among which the greatest polymorphism is observed in tissue breaks. The properties of their distribution, anatomical localization, number, shape, dimensions, direction, edges and bottom depend on the type of external impact (impact, compression, etc.) and its intensity, direction and place of application of the wounding force, the area of the contact surface. After the properties of the specified discontinuities have established the appropriate morphological equivalents, they can be used to diagnose the mechanisms and states of their formation.

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