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X-RAY DIAGNOSTICS OF FIRE DAMAGE VESSELS OF THE ABDOMINAL CAVITY OF THE RETROPERITONEAL SPACE

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This article deals with the analysis of damage to the main vessels of the abdominal cavity. In particular, the article is devoted to the radiological diagnosis of damage to the vessels of the abdominal cavity caused by gunshot wounds. The article examines various methods and technologies of using X-ray and computer tomographic imaging for accurate localization and characterization of damage to the vascular bed. The author of the article emphasizes the importance of the clinical significance of such a diagnosis, its advantages, and possible limitations in its use for effective treatment of victims. A detailed review of foreign research was conducted to adapt and study the existing world experience in the direction of research for the opportunity to provide timely and high-quality assistance to victims.

The aim. The aim of the work is the theoretical substantiation of gunshot injuries to the main vessels of the abdominal cavity of the retroperitoneal space.

Scientific novelty. For the first time, a detailed analysis of damage to the main vessels of the abdominal cavity of the retroperitoneal space was carried out.

Materials and methods. Analysis of theoretical sources, comparison, induction of isolated analytical data. The research was conducted on the basis of the repository of scientific texts of the State Institution "Amosov National Institute of Cardiovascular Surgery of the National Academy of Medical Sciences of Ukraine".

Results. It was determined that with the help of MSCT-angiography, signs of damage to the main vessels of the abdominal cavity can be accurately diagnosed, additional information about damage to bone structures, neighbouring organs and tissues is obtained.

Conclusions. It was determined that MSCT-angiography has become the main method of assessing gunshot injuries to the vessels of the abdominal cavity. Using this method allows you to accurately determine the location and nature of injuries, which helps doctors in choosing the optimal treatment plan for affected patients. However, it is important to consider the possible limitations of this method and to develop additional diagnostic strategies for a complete and comprehensive assessment of vascular injuries

Keywords: gunshot wounds, wound channel, main vessels of the abdominal cavity, MSCT-angiography

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1. Introduction

During the full-scale war in Ukraine, the study of gunshot wounds remains relevant and unquestionable. It should be noted that abdominal gunshot wounds (AGW) are a severe modern combat injury, which causes difficulties in choosing adequate surgical tactics and effective methods of medical visualization of combat injuries in conditions of full-scale war.

Damage to the abdomen and pelvis in the overall structure of sanitary losses in gunshot wounds is up to 4.9–7.7 % [1]. The severity of injuries in penetrating wounds of the abdominal cavity and pelvis is caused not only by injury to parenchymal and hollow, but also to the main vessels of the abdominal cavity with the development of hemoperitoneum of retroperitoneal hematoma.

The aim of the work is the theoretical substantiation of gunshot injuries to the main vessels of the abdominal cavity of the retroperitoneal space.

2. Materials and methods

The theoretical and methodological analysis was carried out on the basis of the repository of scientific texts of the State Institution "Amosov National Institute of Cardiovascular Surgery of the National Academy of Medical Sciences of Ukraine" on the basis of keywords: radiation diagnostics, gunshot wounds, main vessels of the abdominal cavity, MSCT-angiography.

3. Research results and their discussions

The question of the necessity and scope of urgent radiation examination of patients with gunshot combat trauma of the abdomen and pelvis is not clearly defined. Today, the method of primary investigation for gunshot wounds, which allows to determine the nature of the wound, the expected damage to parenchymal, hollow organs, is traditional radiography. Overview radiography in two projections, polypositional radiography allows to

detect only indirect signs of intra-abdominal bleeding (hemoperitoneum), retroperitoneal hematoma, as well as more reliable – in case of damage to hollow organs, diaphragm, bone structures: free gas, deformation of the dome of the diaphragm, displacement of intestinal loops into the pleural cavity, violation of the integrity of bone structures [2].

Previously used x-ray techniques for wound contrast (vulnerography) to establish the penetrating nature of an abdominal wound are used much less often today. X-ray diagnosis of gunshot injuries to the organs of the abdominal cavity and pelvis, and even more so a detailed description of these injuries in the injured, who are in a critical condition, hemorrhagic shock, is not necessary since the fact of a penetrating wound of the abdomen is a sufficient indication for urgent laparotomy [2].

Stability of hemodynamics is the main condition for X-ray examination of patients with gunshot wounds of the abdominal cavity and pelvis. Patients with unstable hemodynamics and obvious signs of damage to internal organs and with intra-abdominal bleeding require urgent surgical intervention without preliminary research [3].

In the case of gunshot wounds to the organs of the abdominal cavity and pelvis, the traditional sequence of the examination, namely: inspection radiography, ultrasound research methods, MSCT; may be violated, in which case it shifts in favour of performing MSCT (if technically possible), displacing traditional radiography [4].

MSCT-angiography makes it possible to accurately identify the nature and degree of gunshot injury of internal parenchymal organs, which is accompanied by damage to intra-organ vessels and leads to intra-abdominal and abdominal bleeding [5].

The advantage of ultrasound of the abdomen and pelvis in case of gunshot wounds, which is performed to determine the degree of peritoneum and identify the source of bleeding, is the possibility of conducting it in the emergency surgery department, intensive care unit, and trauma department at the patient's bedside. This allows you to reliably detect a non-specific sign of bleeding – the presence of free fluid in the abdominal cavity. But the ultrasound diagnosis of damage to the organs of the abdominal cavity, the retroperitoneal space of the pelvis is complicated by reflex paresis of the intestines and flatulence, the presence of large soft tissue injuries in the projection of the ultrasound window, bandages, and drains [6].

To date, MSCT competes with diagnostic peritoneal lavage in the detection of intra-abdominal bleeding in gunshot wounds of the abdomen and pelvis and has almost supplanted it. Traditional selective angiography is used in special cases and as X-ray surgical interventions to stop bleeding (embolization of a bleeding vessel, disconnection of the AB joint). The role of MRI in abdominal trauma, and even more so in gunshot wounds, is small due to the presence of metallic foreign bodies, due to the difficulty of monitoring hemodynamics, ventilatory support, and maintaining vital functions in the wounded [5].

According to the statistics of gunshot wounds of the abdominal cavity, the liver is the second among parenchymal organs in terms of the frequency of gunshot injuries leading to intra-abdominal bleeding – 22.4 %.

The main indication for selective angiography in victims is such complications as prolonged or repeated bleeding into the abdominal cavity, hemophilia, arteriovenous fistulas. X-ray surgical interventions in these cases are used to finally stop bleeding by means of embolization of the bleeding vessel or implantation of a graft-stent to disconnect the pathological vascular joint [7].

According to various studies, damage to the main vessels of the abdominal cavity of the retroperitoneal space during gunshot wounds occurs in 7–11 % of the wounded, while damage to other organs of the abdominal cavity is noted in 90.3 % of cases [8]. The condition of patients is usually severe or extremely severe in 79.8 % of cases, which is due to hemorrhagic shock. In most cases, the vessels of the mesenteric root (upper and lower mesenteric vessels) are damaged – up to 55.6 %, less often the iliac vessels – 17.8 %, the inferior vena cava – in 8 % of cases [1].

For the diagnosis of gunshot injuries of the parenchymal organs of the abdominal cavity, pelvis, and retroperitoneal space, accompanied by intra-abdominal bleeding, the method of choice continues to be ultrasound, which is highly informative and simple [9].

The use of mobile ultrasound systems allows this study to be carried out on victims who are in a serious condition, in intensive care conditions. However, the presence of gas in the abdominal cavity and pronounced flatulence significantly complicate ultrasound examinations for visualization of the vessels of the abdominal cavity and retroperitoneal space [3]. In such cases, MSCT-angiography is the optimal method of radiation diagnosis of gunshot injuries to organs and main vessels of the abdominal cavity, retroperitoneal space, and pelvis, which allows to recognize with high accuracy traumatic injuries of internal organs, intra- and extra-organ hematomas, the source of intra-abdominal bleeding [10].

C Quin, Richard Sinert systematically reviewed the medical literature on the utility of the Focused Assessment with Sonography for Trauma (FAST) test for detecting free intraperitoneal blood after penetrating trunk trauma in penetrating trunk trauma. The researchers searched the PUBMED and EMBASE databases for randomized controlled trials from 1965 to December 2009 using the strategy. It was found that the FAST study is a highly specific method in the diagnosis of injuries in penetrating trauma of the abdominal cavity – 94.1–100.0 %, but not a very sensitive – 28.1–100 % diagnostic method [11].

Studying literary sources, we would like to note that the results of three-phase MSCT – angiography are often found. Ernesto Lima Araujo Melo, Marcjs Roberto de Menezes, Giovanni Guido Cerri conducted a study to access the accuracy of multidetector computed tomography in the diagnosis of injuries in hemodynamically stable victims with abdominal gunshot wounds. Triple-contrast MSCT angiography was performed in hemodynamically stable gunshot wounds during a 20-month prospective study of diagnostic accuracy. Thirty-one patients (30 men, 1 woman; mean age 24.3 years) were evaluated by two radiologists for signs of damage to solid and hollow organs, vascular structures, bladder, diaphragm, fractures, and gross findings (free fluid, pneumoperitoneum) and lesions ripple. All patients un-

derwent laparotomy and prevalence, sensitivity, specificity, accuracy, and positive and negative predictive values were calculated. No statistically significant differences between radiologists were found. All lesions of solid and hollow organs, vascular lesions and general symptoms were detected. One of four bladder lesions was missed by MSCT, resulting in this case in a sensitivity of 75 %, specificity of 100 %, positive predictive value of 100 %, negative predictive value of 96.4 %, and accuracy of 96.8 % ($p=0.001$). One out of eight diaphragmatic lesions was not detected by MSCT-angiography, with a sensitivity of 87.5 %, specificity of 100%, positive predictive value of 100 %, negative predictive value of 95.8 %, and accuracy of 96.8 % ($p < 0.001$). Fractures were diagnosed in 74.4 % of patients (24 out of 31). Fourteen (43.2 %) patients demonstrated a non-therapeutic laparotomy in which minor lesions could be treated conservatively. It was determined that MSCT - angiography is an accurate imaging method for the evaluation of selected abdominal gunshot wounds, which provides reliable information to emergency department doctors [12].

Even though mandatory laparotomy has always been the standard of care for patients with gunshot wounds of the abdominal cavity, in recent decades there have been reports in the literature about new approaches and protocols for the management of such patients. A fundamental review based on a meta-analysis of 41 clinical studies including 22,847 patients with gunshot wounds of the abdominal cavity is given in foreign literature. From this category, 6,777 (29.7 %) victims underwent dynamic monitoring, which consisted in performing MSCT – angiography of the abdominal cavity and pelvis with the appearance of clinical symptoms of damage to parenchymal organs, intra-abdominal bleeding. At the same time, it was possible to reduce the number of laparotomies to 4.1 %. The authors claim that MSCT-angiography significantly reduces the number of unwarranted laparotomies and should be widely used in dynamic observation of the injured to determine surgical tactics [13].

In the case of gunshot wounds of the pelvis, according to domestic and foreign research, the primary method of urgent radiological diagnosis is the direct

projection X-ray of the pelvis, which allows to determine the traumatic damage to the bones of the pelvic ring, the anatomical localization of the injuring projectiles (shrapnel, bullets). In order to clarify the nature of damage to the pelvic organs, which determine the surgical tactics, the scope of radiological research is expanded to the use of ultrasound research methods aimed at detecting free fluid (blood, urine) in the small pelvis, which are limited due to intestinal pneumatosis, the presence of a wound surface [14].

Study limitations. Our research is limited by a rather low base of literary data on the topic of study.

Prospects for further research. In further investigations, an analysis of clinical cases of gunshot injuries to the vessels of the abdominal cavity will be carried out.

4. Conclusions

It was determined that MSCT-angiography has become the main method of assessing gunshot injuries to the vessels of the abdominal cavity. Using this method allows you to accurately determine the location and nature of injuries, which helps doctors in choosing the optimal treatment plan for affected patients. However, it is important to consider the possible limitations of this method and to develop additional diagnostic strategies for a complete and comprehensive assessment of vascular injuries.

Conflict of interests

The authors declare that they have no conflict of interest in relation to this research, including financial, personal, authorship or other nature, which could affect the research and its results presented in this article.

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Data availability

The manuscript has no associated data.

Use of artificial intelligence

The authors confirm that they did not use artificial intelligence technologies when creating the current work.

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