Chapter 4

FORENSIC VETERINARY EXAMINATION OF TRAUMATIC INJURIES IN ANIMALS CAUSED BY AIRGUNS AND FIREARMS: PATTERNS, SEVERITY AND CONSEQUENCES

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INTRODUCTION

In many countries around the world, attention to animal welfare issues is noticeably increasing. This is evidenced by significant changes in the perception of the moral and ethical aspects related to protecting animals from cruel treatment, mutilation, and the intentional or unintentional infliction of death[1, 2, 3].

Ukraine has demonstrated its commitment to guaranteeing animal welfare and protecting them from cruelty by implementing a number of important laws. These include directives from the European Union and the European Convention on the Protection of Domestic Animals, which define standards and obligations in this field. The current Constitution of Ukraine, namely Article 27, enshrines the right to life and freedom from cruelty for all living beings; The Civil Code of Ukraine, Article 193 recognizes animals as subjects of law that have the right to life and health; Article 194 prohibits cruelty to animals; The Law of Ukraine "On the Protection of Animals from Cruelty" is aimed at preventing the suffering and death of animals as a result of cruel treatment, protecting their rights and establishing moral and ethical standards in society regarding animals. In addition to these, numerous other legal acts regulate animal protection in Ukraine. These include requirements for veterinary care, rules for transporting animals, handling stray animals,

[1] Ascione, F. R., et al. The relations among animal abuse, psychological disorders, and crime: Implications for forensic assessment. Behavioral sciences & The Law, 2018, 36.6: 717–729.

[2] Levitt, L., Patronek, G., & Grisso, T. (Eds.). Animal maltreatment: Forensic mental health issues and evaluations. Oxford University Press, USA, 2016.

[3] Корж, Г. В. Християнська етика та проблема захисту тварин. Історія релігій в Україні, 2016, 2-3: 102–107.

and hunting. These all play a vital role in protecting animals and ensuring their well-being[4, 5].

Research by Ottinger (2014) and McDonough (2016) reveals an interesting aspect – hypotheses that animal cruelty poses a serious threat to the moral and democratic values of society, because in most cases it is a prerequisite for violent treatment of people, are seen in in these actions, there is a cause-and-effect relationship between violence towards an animal and the generation of aggression towards other people[6, 7].

The use of firearms or pneumatic weapons against animals contradicts the principles of humane treatment. Vertebrate animals, like humans, are capable of feeling pain, fear, helplessness and suffering. Injuring, maiming or killing them with the use of various types of weapons is a cruel and unjustifiable act that contradicts ethical principles and violates the animal's right to life[8]. Such actions are considered a crime against animals and the guilty persons are criminally responsible under Article 299 of the Criminal Code of Ukraine. However, it's important to note that not all situations involving animal death by weapons are considered cruel. For example, killing animals in self-defense or protecting people may be justified in some situations[9].

During the investigation of offenses related to the death of animals with the use of weapons, their cruel treatment, to establish facts and circumstances that have legal significance, the most qualified form of using special knowledge in the judiciary of Ukraine, as in all democratic countries of the world, is forensic examination[10].

The forensic veterinary expert meticulously evaluates the nature of the injuries, their localization, establishes the mechanism of the injury and the possible instrument of injury, determines the level of the animal's suffering, which may include an assessment of pain and discomfort. Additionally, the expert assesses the history of injuries and their impact on the general

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[4] Про захист тварин від жорстокого поводження: Закон України, прийнятий 21.02.2006 р., № 3447-IV.

[5] Кримінальний кодекс України / Ю. В. Баулін, В. І. Борисов, С. Б. Гавриш та ін. / за заг. ред. В. Т. Маляренка, В. В. Сташиса, В. Я. Тація. Х.: "Одісей", 2004. Вид. 2. 1152 с.

[6] Ottinger T, Rasmusson B, Segerstad CH, Merck M, Goot FV, Olsén L, Gavier-Widén D. Forensic veterinary pathology, today's situation and perspectives. Vet Rec. 2014 Nov 8;175(18):459. doi: 10.1136/vr.102306.

[7] McDonough SP, McEwen BJ. Veterinary Forensic Pathology: The Search for Truth. Vet Pathol. 2016 Sep;53(5):875-7. doi: 10.1177/0300985816647450

[8] Bradley-Siemens N, Brower AI. Veterinary Forensics: Firearms and Investigation of Projectile Injury. Vet Pathol. 2016 Sep; 53(5):988–1000. doi: 10.1177/0300985816653170.

[9] Головко, І. А. Кримінальна відповідальність за жорстоке поводження з тваринами. Київський національний університет внутрішніх справ. Київ. 2010.

[10] Яценко, І. В. Завдання судово-ветеринарної експертизи: теоретичні й праксеологічні проблеми та шляхи їх вирішення. Forum Prava. 2023.

condition and health of the animal, taking into account the presence or absence of acute or chronic diseases[11].

It is common knowledge that firearms are dangerous tools that can inflict severe injuries or death on animals. In contrast, pneumatic weapons are often perceived by the public as relatively safe, primarily used for recreational activities like sports, training, and entertainment. However, this perception is misleading. Powerful pneumatic guns can fire projectiles that penetrate the skin, soft tissues, and muscles, therefore, cause serious injuries and life-threatening to animals. Gunshot wounds in animals can be the consequence of fire arms as well as pneumatic arms[12].

Gunshot wounds in animals are complex, penetrating wounds, which are characterized by a significant tissue defect (minus a tissue), a belt of sedimentation and abrasion, blood-soaked edges with areas of necrotic changes around the wound canal, resulting from the penetrating action of a projectile fired from the barrel of a weapon under the action of gases produced by the combustion of the powder charge of the ammunition. In forensic veterinary practice, bullet and pellet gunshot injuries are the most common[13].

Air gun wounds in animals exhibit significant variability from a pathomorphological perspective. This variability primarily depends on the speed, size, and shape of the projectile, the direction of the shot, and the body part impacted. Fired from a pneumatic weapon by compressed air or gas mixtures, a pneumatic bullet acquires sufficient kinetic energy (typically under 100 meters per second). Upon impact with soft tissues, the bullet pushes them apart, causing disruption of anatomical structures. The resulting damage resembles a puncture wound. Unlike firearm injuries, air gun wounds lack tissue burns and gunpowder particles[14].

Forensic veterinary examination of traumatic injuries caused by airguns can be a real challenge due to the lack of clearly recognizable signs caused by the increased power of this type of weapon and the widespread use of medium and large caliber rifles. The correct interpretation of gunshot and air gunshot wounds by forensic veterinary experts not only provides valuable information that can assist law enforcement agencies in their investigation but is primarily important for making an accurate diagnosis. Therefore, this

[11] Лемішевський, В. М. Судово-ветеринарна експертиза трупа собаки із ознаками насильницької смерті: огляд випадку. In: Conference "Modern methods of diagnostic, treatment and prevention in veterinary medicine". 2021. p. 98–99.

[12] Alexandropoulou Ch-A and E Panagiotopoulos, 2010. Wound ballistics: analysis of blunt and penetrating trauma mechanisms. Health Sci J, 4: 225–236.

[13] Silvia AJ, 1999. Mechanism of injury in gunshot wounds: myths and reality. Crit Care Nurs Q, 22: 69–74.

[14] Santucci RA and YJ Chang, 2004. Ballistics for physicians: myths about wound ballistics and gunshot injuries. J Urol, 171: 1408–1414.

problem remains relevant, as information on traumatic injuries from air weapons in animals is not sufficiently presented in the scientific literature and forensic veterinary medicine[15, 16, 17].

Materials and methods

The material for analysis consisted of forensic veterinary conclusions prepared by the Department of Normal and Pathological Morphology and Forensic Veterinary Medicine at Stepan Gzhytskyi National University of Veterinary Medicine and Biotechnologies of Lviv during the years 2022-2024. All expert opinions were prepared based on the resolution of the investigator, investigating judge or the court ruling under Articles 110, 242, 243 of the Criminal Procedure Code of Ukraine in criminal proceedings, for signs of criminal offenses stipulated by Article 299 of the Criminal Code of Ukraine.

Post-mortem examination of animal corpse was conducted using the traditional method (forensic veterinary necropsy), which involved a thorough external examination followed by the opening of body cavities for internal examination, including the removal of internal organs, including the brain, from the animal's body for detailed examination.

As additional investigative methods, X-raying of animal corpse was performed.

1. Pneumatic and firearms: mechanisms of injury and consequences for animals

Ukrainian legislation on firearms, pneumatic weapons, and other types of weapons clearly defines the legal regime of ownership, basic rights, and obligations of citizens regarding the purchase, possession, and use of weapons and ammunition.

In Ukraine, the use of pneumatic weapons with a barrel caliber not exceeding 4.5 mm and a bullet velocity not exceeding 100 meters per second does not require a permit or special registration for possession. Air pistols and rifles are used mainly for sports shooting. The storage and use of this type of weapon is regulated by the order of the Ministry of Internal Affairs of Ukraine dated August 21, 1998 No. 622, as amended. There are no legal restrictions on the type or quantity of ammunition that can be possessed.

[15] Kolata RJ. Trauma in dogs and cats: an overview. Vet Clin North Am Small Anim Pract. 1980 Aug;10(3):515-22. doi: 10.1016/s0195-5616(80)50051-3.

[16] Burnie AG, Kydd DM. Airgun injuries. Vet Rec. 1985 Feb 9;116(6):167-8. doi: 10.1136/vr.116.6.167.

[17] Vnuk D, Capak H, Gusak V, Maticic D, Popovic M, Brkljaca Bottegaro N. Metal projectile injuries in cats: review of 65 cases (2012-2014). J Feline Med Surg. 2016 Aug;18(8):626-31. doi: 10.1177/1098612X15590869.

However, this does not exempt the person who owns this type of weapon from administrative and criminal liability when used for an illegal purpose[18].

Traumatic injuries in animals caused by weapons can usually result from the use of both firearms and air weapons. Wounds caused by low-powered pneumatic weapons may not be immediately noticeable. Pet owners may not even know their pet has been injured because the wound entrance can be so small that it can go unnoticed due to the animal's thick coat. An exception may be a shot from close range, capable of causing fatal damage. While injuries from a powerful air rifle have significantly pronounced signs and pose a direct threat to the life and health of the animal[19].

A firearm is a weapon structurally designed for mechanical damage to a target at a distance with a projectile (bullet, shot, buckshot), which receives directional movement in the barrel due to the energy of the explosion of a powder or other charge and has a sufficient striking ability, which in turn has a direct dependence on projectile mass and speed. As a rule, such wounds are through.

Firearms are fueled by cartridges, which consist of a projectile (bullet, shot, or pellets), a casing, a propellant charge, and a primer. The bullet may be equipped with a lead, aluminum, or steel core, which is further coated with a copper-zinc alloy. The shape of such bullets is cylindrical with a rounded head or pointed[20].

During a shot, the mechanical striker hits the cartridge capsule, causing the powder charge to ignite and the formation of a large amount of heated gases. Under high pressure, these gases push the projectile down the barrel. Half-burnt particles of the powder charge, grease and metal particles from the surface of the projectile and the inner surface of the sleeve and barrel can follow the bullet into the target[21].

A projectile fired from a firearm has significant kinetic energy and exerts a mechanical effect (impact, hydrodynamic, bursting) on the animal's body. When the bullet collides with the animal's body, the projectile generates a powerful impulse in a very small area, which leads to a sharp compression of the tissues at the point of impact, due to the rapid compression, part of the tissues cannot withstand the pressure and is knocked out (minus tissue).

[18] Про затвердження Інструкції про порядок виготовлення, придбання, зберігання, обліку, перевезення та використання вогнепальної, пневматичної, холодної і охолощеної зброї, [текст] : Наказ; МВС України від 21.08.1998 № 622 URL: https://zakon.rada.gov.ua/go/z0637-98 (дата звернення: 04.04.2024).

[19] Houszka, M.; Kapuśniak, V.; Nowak, M.. Postrzał z broni pneumatycznej jako przyczyna śmierci psa. Medycyna Weterynaryjna, 2007, 63.11.

[20] Felsmann, M. Z., et al. A review of firearms, projectile and gunshot wounds in animals. Pakistan Veterinary Journal, 2014, 34.3.

[21] Hollerman JJ, ML Fackler, DM Coldwell and Y Ben-Menachem, 1990a. Gunshot wounds: 1. Bullets, ballistics and mechanisms of injury. A J Roentgenol, 155: 685–690.

At the moment of the impact, a strong compression wave occurs, spreading to the surrounding tissues from the point of impact, which generates an oscillatory movement of the walls of the wound channel. These fluctuations can lead to damage to blood vessels and nerves, as well as tissue tears (hydrodynamic action). The explosive effect of the bullet is characterized by the destruction of dense environments, such as bones, cartilage and internal organs[22].

Depending on the angle of entry of the projectile, the wound may have a round or oval shape with finely serrated edges. The bullet, passing through the skin, breaks the integrity and injures the edges of the epidermis, over time the edges dry up, become dense and acquire a dark brown color. Also, around the wound opening, a rim of contamination from grease, soot, traces of incomplete combustion of the powder charge was found. The shape and size of the wound channel mainly depends on the caliber of the bullet, the speed, the nature of the movement and the properties of the affected tissue[23].

The exit bullet hole in most cases is wider and larger, has a star or irregular shape, which is due to the fact that the bullet loses a significant part of its kinetic energy when exiting the body, deforms and tears the skin upon exit, unlike the entrance bullet hole. It is worth noting that around the outlet there will be no soot and particles of gunpowder, as well as rims of peeling and wiping[24].

Pneumatic weapons are weapons that are designed to hit a target with a projectile (bullet, pellets) by means of the instantaneous expansion of pre-compressed air or other gas in the barrel, followed by the conversion of mechanical energy into the kinetic energy of the projectile flight[25].

The nature of air gun damage depends primarily on the power of the weapon (directly proportional to the mass and speed of the projectile) and the affected area of the animal's body. When using low-powered air weapons, in which the initial speed of the bullet does not exceed 100 m/s, a wedge-shaped effect of the projectile on the tissue is observed. This means that the bullet, pushing the tissues apart, passes through them like a prickly object, the edges of the wound are aligned with the tissue defect. In cases of using a powerful pneumatic weapon (rifle) with a bullet firing speed of more than 300-350 m/s, which has almost the same parameters as a firearm, the entrance bullet hole will have a rounded or oval shape, with a slight abrasion

[22] Bradley-Siemens, N. Gunshot Wounds and Wound Ballistics. In: Veterinary Forensic Medicine and Forensic Sciences. CRC Press, 2020. P. 157–178.

[23] Maiden N, 2009. Historical overview of wound ballistics research. Forensic Sci Med Pathol, 5: 85–89.

[24] Weis, C., et al. Shooting distance estimation using gunshot residue on mammalian pelts. 2017. PhD Thesis. Master's Thesis. The Pennsylvania State University.

[25] Munro R, Merry D. Airgun pellets in animals. Vet Rec. 2006 Jun 10;158(23):808. doi: 10.1136/vr.158.23.808-a.

belt, small serrated edge, present a "minus a tissue" defect, the diameter of which in most cases will correspond to the caliber of the bullet[26, 27].

In particular, one of the most important aspects of the investigation of crimes involving the use of firearms and pneumatic weapons is to determine the angle or trajectory of the shot. This allows you to visualize and characterize the trajectory of the projectile, as well as confirm or refute the testimony of witnesses or the suspect in the crime, if any. Thus, this stage of the investigation is also critical for a comprehensive and objective establishment of events related to the crime[28, 29, 30].

2. Forensic veterinary examinations: case analysis

The exchange of experience between forensic veterinary experts is important for improving the quality of expert activity in Ukraine. For this purpose, the author offers his own experience of conducting forensic veterinary examinations, which were performed at the Department of Normal and Pathological Morphology and Forensic Veterinary Medicine at the Stepan Gzhytskyi National University of Veterinary Medicine and Biotechnologies of Lviv.

The conclusion of the forensic veterinary examination in criminal proceedings No. XXXXXX41160000076 dated 01.03.2024 on the grounds of a criminal offense provided for in Part 1 of Article 299 of the Criminal Code of Ukraine.

From the resolution of the investigator, it is known that on February 22, 2024, in the Lviv region, in the city of Brody, between 3:00 PM and 4:00 PM, an unknown person shot a mixed-breed dog named "Archie".

According to radiographic examination of the dog's corpse in lateral projection, in the area of ribs 7–8 of the thoracic cage on the right side, a radiopaque area was detected, a foreign body resembling a bullet from a pneumatic weapon (Fig. 1).

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[26] Clasper J. 2001. The interaction of projectiles with tissues and the management of ballistic fractures. JR Army Med Corps. 147:52–61.

[27] Keller JE, Hindman JW, Kidd JN, Jackson RJ, Smith SD, Wagner CW. Air-gun injuries: initial evaluation and resultant morbidity. Am Surg. 2004 Jun;70(6):484-90.

[28] DiMaio VJ. Gunshot wounds: practical aspects of firearms, ballistics, and forensic techniques. CRC press, 2015.

[29] Thoma V, Franchetti G, Geisenberger D, Glardon M, Kromeier J, Mierdel K, Pollak S, Wimmer S, Perdekamp MG. Gunshot wounds in parenchymatous organs: the morphology mainly depends on the physical properties of the affected tissues. Int J Legal Med. 2023 Sep;137(5):1463-1469. doi: 10.1007/s00414-023-03058-2.

[30] Яценко, І. В., et al. Судово-ветеринарна експертиза та оціночні критерії смертельних вогнепальних поранень тварин (із експертної практики). *Проблеми зооінженерії та ветеринарної медицини*, 2015, 30 (2): 325–346.

Fig. 1. A foreign body (bullet) in the area of the 7-8 intercostal space of the chest. Dog, side view. Radiograph.

During the external examination of the dog corpse, a mammal of the Canidae family, male, with a reddish coat, approximately two years old, weighing 9.1 kg, it was noted to have a correct, proportionate body configuration, with semi-flexed front limbs. Postmortem cooling is present, rigor mortis is absent, skeletal muscles are soft, and the limbs flex freely at the joints. The coat is well-retained in the hair follicles. The eyes are closed, the cornea is somewhat cloudy. The conjunctiva is dry, grayish in color. The oral cavity is closed. The tongue is pale pink, dull. The teeth are white, strong, the canine teeth are sharp, the lower incisors are not worn. Visible mucous membranes are pale. The anal opening is closed. No discharge is observed from natural openings. In the area of ribs 6–7 of the thoracic cage on the left side, there is a traumatic skin injury measuring 5 mm in diameter, round in shape with relatively smooth festooned edges and tissue defect, with the surrounding fur stained with blood.

During the internal examination, it was noted that the subcutaneous tissue is well-developed, and in the area of ribs 6–7 on the left side, there is a hemorrhage measuring 10 cm in diameter (Fig. 2). The muscles are red in color, with the characteristic muscle structure preserved except for the injured area. The organs of the thoracic and abdominal cavities are anatomically positioned correctly. The costal pleura is gray in color, moderately moist, and shiny. In the thoracic cavity, there is red fluid measuring 370 ml. On the left side, in the area of ribs 6–7 of the thoracic cage, there is an entrance gunshot wound measuring 5.0 mm in diameter, round in shape with hemorrhages at the periphery.

The lungs are of characteristic shape, pale pink in color. In the left middle and right posterior lobes of the lungs, crater-like depressions of round shape, dark red in color, with a diameter of 6.0–7.0 mm are present (Fig. 3).

Fig. 2. Massive hemorrhage in the area of 6-7 ribs of the chest wall. Dog.

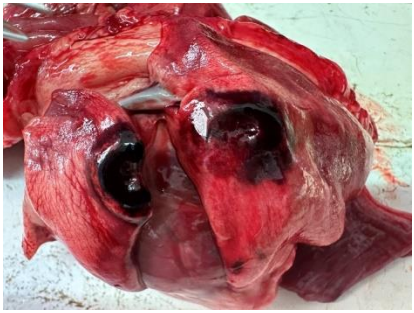

Fig. 3. Traumatic injuries of the left middle and right posterior lobes of the lungs. Dog.

The wound channel ran obliquely caudally from left to right, passing through the skin and subcutaneous tissue, thoracic wall, left middle and right lower lobes of the lungs, thoracic wall (Fig. 4), and blindly terminated in the subcutaneous tissue in the area of the 7–8th intercostal space on the right side (Fig. 5).

Fig. 4. The direction of the wound channel of a penetrating pneumatic bullet wound. Dog.

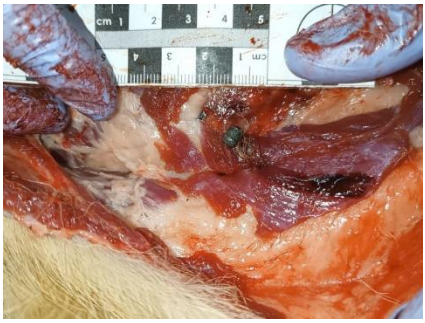

Fig. 5. A bullet in the subcutaneous tissue in the area of the 7-8 intercostal space on the right side of the chest wall. Dog.

The mucous membrane of the trachea is unevenly colored, permeated with fluid of a dark cherry hue. Bloody fluid is present in the lumen of the trachea and bronchi. The heart, rounded in shape, is slightly enlarged due to the right half, the cavities of the right atrium and ventricle contain a dark cherry color. The ratio of the thickness of the right ventricle to the left is 1:4. The diaphragm is pale pink in color, intact, and smooth.

The liver is unevenly colored, ranging from light brown to clay-colored, with slightly rounded edges, tense capsule, flabby consistency, and a small amount of blood oozing on section. The gallbladder is filled with a moderate amount of yellow-green fluid. In the area adjacent to the gallbladder, there is infiltration of the liver parenchyma and loops of intestines by a yellow-green infiltrate. The stomach is moderately filled with feed masses. The mucous membrane is gray in color, moist, shiny, and covered with a moderate amount of mucus. The small and large intestines contain a moderate amount of content; their mucous membrane is pale pink, moist, and shiny. The pancreas is pale pink in color, unevenly colored. The spleen is ribbon-shaped, with a flaccid consistency, pale red in color, and sharp edges. The lymph nodes are gray in color, shiny and moist on section. The kidneys are red in color, with an elastic consistency, not enlarged, of characteristic anatomical shape, and the boundary between the cortical and medullary substance is preserved on section. The urinary bladder is filled with clear straw-colored fluid, its mucous membrane is gray in color and smooth.

Thus, during the pathological examination of the dog's corpse, one bullet with slight deformation on the surface of the semi-spherical head portion, weighing 0.54 g, was extracted (Fig. 6).

Fig. 6. A bullet with slight deformation on the surface of the semispherical head portion. Macrophoto

The entrance pneumatic bullet wound was located in the area of the 6th to 7th intercostal space of the chest on the left side, oval in shape with slight settling at the upper edge, relatively even edges, and a central defect (minus a tissue) with a diameter of 5 mm, indicating a shot from a non-close distance. The wound channel traversed through the skin, subcutaneous tissue, chest muscles on the left side, costal pleura, left and right lung lobes, right lateral chest wall, and terminated blindly in the subcutaneous tissue on the right. Injury to the right and left lung lobes resulted in bleeding, acute posthemorrhagic anemia impairment of the cardiovascular system function, and the dog's death.

The forensic veterinary examination determined that the dog's death resulted from a blind penetrating pneumatic bullet wound affecting the left and right lung lobes, leading to traumatic shock, respiratory dysfunction, and post-hemorrhagic anemia. The injuries found on the dog's body were ante-mortem, causing pain and physical suffering to the animal. There is a direct causal relationship between the injuries and the cause of death of the animal.

The conclusion of the forensic veterinary examination in criminal case No. XXXXX41250000070 dated 13.02.2024 for signs of a criminal offense under Part 1 of Article 299 of the Criminal Code of Ukraine.

From the resolution of the investigator, it is known that on February 13, 2024, in the village of Pesochna, Stryi district of Lviv region, a cat of unidentified breed, reddish in color, was found with an injury to the area of the left thigh, which could have been caused by a gunshot from an air rifle, indicating probable cruel treatment of the animal leading to its death.

The research object is delivered in a special package, the valves of which are tightly sealed. The integrity of the package is not violated.

Based on the results of radiographic examination of the body of a male cat, approximately three years old, of reddish color, two foreign bodies resembling bullets were found. One bullet was localized in the area of the left elbow joint, and the other was found in the abdominal cavity (Fig. 7).

The necropsy of a domestic cat (Felis silvestris catus), male, of red coloration, approximately three years old, was conducted on February 14, 2024, in the dissecting room of the Department of Normal and Pathological Morphology and Forensic Veterinary Medicine at the Stepan Gzhytskyi National University of Veterinary Medicine and Biotechnologies.

During the external examination of the cat's body, pronounced postmortem cooling and stiffening were noted. The fur adhered well to the hair follicles. The eyes were half-closed, with shiny corneas. The oral cavity was closed. Visible mucous membranes were pale. The anal opening was closed. No natural secretions were observed. External traumatic damage to the skin and subcutaneous tissue of the caudal abdominal region, on the left near the thigh, of round shape, with a diameter of 5 mm, was identified, with the surrounding fur stained with blood.

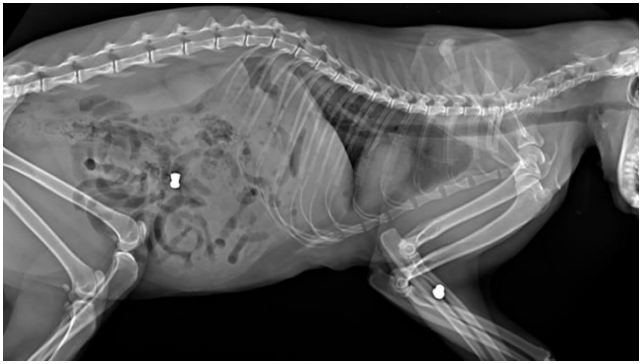

Fig. 7. Two foreign bodies (bullets), one located in the area of the elbow joint of the front left limb, the other – in the abdominal cavity. Cat, lateral projection. Radiograph

The wound channel passed from left to right, slightly obliquely towards the head, through the skin of the caudal abdominal region and subcutaneous tissue, the abdominal wall, the left kidney, and terminated blindly in a massive blood clot in the abdominal cavity.

Along the trajectory of the wound channel in the soft tissues, there are hemorrhages present. The subcutaneous adipose tissue is well developed, abdominal muscles on the left side of the abdominal wall are damaged with hemorrhages, while other groups of skeletal muscles are intact, resilient, light-red in color, with characteristic muscle structure preserved, except for the injured area. The gunshot wound is oval-shaped, with a diameter of 6 mm (Fig. 8).

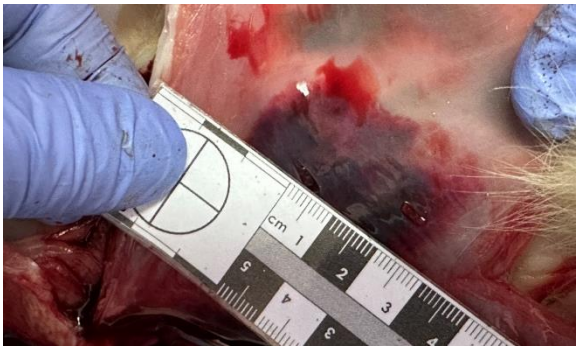

Fig. 8. Traumatic injury to the abdominal wall in the left caudal region of the abdominal cavity. Cat.

The organs of the thoracic and abdominal cavities are anatomically positioned correctly. The serous coverings of the thoracic and abdominal cavities are moist, glossy, and pale. The fibrous capsule of the left kidney is damaged, with characteristic fragmentation of a limited area of the cortical substance and massive hemorrhaging into the adipose capsule of the kidney. The wound channel blindly terminated in masses of clotted blood containing a bullet with a rounded head and a conical, hollow skirt inside, weighing 0.75 grams (Fig. 9).

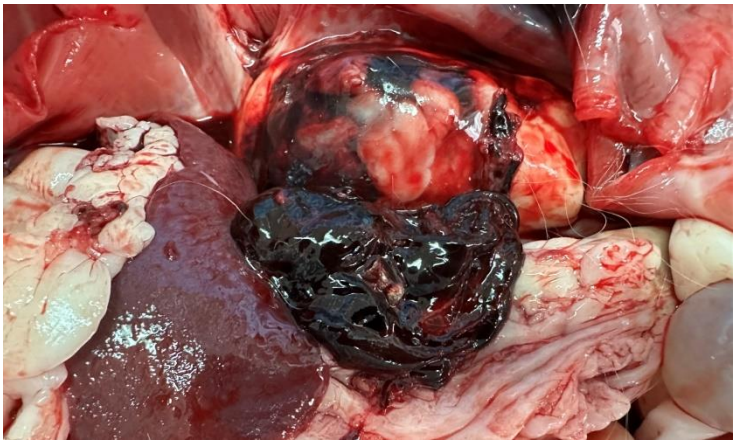

Fig. 9. Hemorrhaging in the renal cortex and adipose capsule of the kidney. Massive clot of blood in the abdominal cavity with a lead bullet inside. Cat

The right kidney is slightly enlarged, the fibrous capsule is easily removed, and the organ's consistency is elastic. The liver is light brown in color, with slightly rounded edges, a tense capsule, preserved structure on the cut surface, and elastic consistency. The gallbladder is moderately filled with bile. The urinary bladder is empty. The pancreas is pale pink, with heterogeneous consistency: sometimes softened, and in other areas, it is elastic. The gastric mucosa is pale pink, moist, and shiny. The small and large intestines have a moderate amount of content, with the mucous membrane of the small intestine being pale pink, moist, and shiny. The spleen is reddish-brown, with sharp edges. The lungs are pale pink and fluffy in consistency. The heart is somewhat rounded, with the right ventricle and atrium dilated, filled with blood (the ratio of the thickness of the right ventricle to the left is 1:4).

In the left forelimb, near the elbow joint, a foreign metallic object with a pronounced deformation of the head part, resembling in shape and size a lead pellet from a pneumatic weapon, was found. The projectile was surrounded by regenerative connective tissue, indicating the old of the inflicted trauma (Fig. 10).

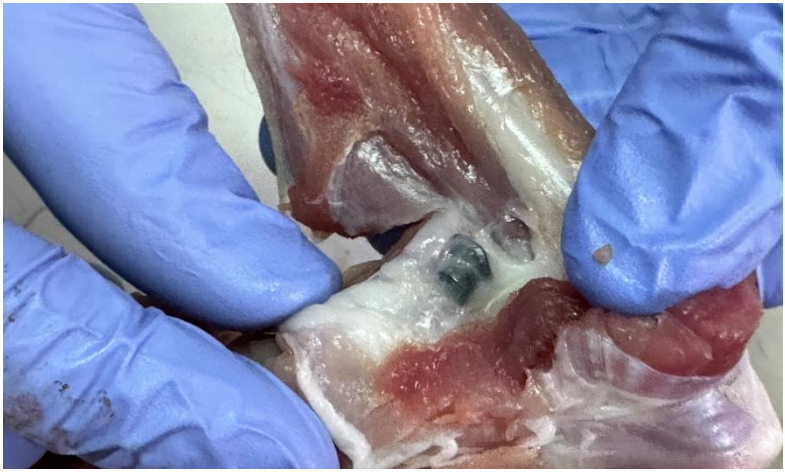

Fig. 10. Lead bullet in the area of the elbow joint of the forelimb. Cat

During the pathological examination of the cat's corpse, two metallic pellets from an air gun were extracted, each weighing 0.75 g. One slightly deformed, and the other with significant deformation of the surface of the main part.

Forensic veterinary examination revealed that the cause of death of the cat was acute bleeding with the development of post-hemorrhagic anemia, resulting from penetrating traumatic injury to the abdominal cavity, involving the skin, subcutaneous tissue, abdominal wall muscles, and the left kidney by a metal bullet from an air gun. Additionally, a second metal pellet from an air gun was found in the left thoracic limb area near the elbow joint, surrounded by regenerative connective tissue. Tissue regeneration in the area of injury to the left thoracic limb indicates that the mentioned injury occurred significantly earlier than the animal's death and should be classified as a minor bodily injury.

The conclusion of the forensic veterinary examination in criminal case No. XXXXXX41390000767 dated 09.08.2023 for signs of a criminal offense under Part 1 of Article 299 of the Criminal Code of Ukraine.

From the resolution of the investigator, it is known that on August 8, 2023, on Kurmanovycha Street in Lviv, near the territory of JSC "Ukrzaliznytsia," the corpse of a dog of an unknown breed was found with multiple penetrating wounds.

During the external examination of the dog's corpse, it was found that the mucous membrane of the oral cavity and conjunctiva were pale. Firearm injuries were localized on the skin of the caudal area of the abdominal wall and the left pelvic limb. On the right side of the caudal area of the abdominal wall, four firearm entry wounds with tissue defects, sedimentation rims, and hair immersion into the wound channel were identified (Fig. 11). The soft tissues in the depth of the wound channel are soaked with blood.

Fig. 11. Multiple gunshot wounds to the right lateral abdomen. Dog

In the caudal region of the abdominal wall on the left side, a rupture of the peritoneum and skin was found, presenting as an extensive irregular wound, measuring 18.0 cm in length and 11.0 cm in width – the exit gunshot wound. Due to the disruption of the anatomical integrity of the skin and peritoneum, loops of small intestines are located outside the abdominal cavity, on the surface of the skin. In the area of the injury, the peritoneum is reddish in color, soaked with blood, with uneven swollen edges. The loops of the protruding small intestines are dark cherry-red in color (Fig. 12).

Fig. 12. The exit hole of the gunshot wound in the left caudal part of the abdominal wall. Dog

On the left pelvic limb, a skin defect measuring 4.0 cm in length and 3.0 cm in width was identified. The subcutaneous tissue and abdominal wall muscles in the area of the gunshot entry wounds and wound tracts are necrotic, with hemorrhages and swelling. In other areas of the dog's body, the skeletal muscles are slightly soft and pale red in color. The serous membranes of the thoracic cavity are moist. The mucous membrane of the pharynx and trachea is pale gray in color and dull. The esophagus and stomach are intact, without damage; their mucous membrane is light gray and pale. The heart is rounded in shape, enlarged due to the cavities of the right atrium and ventricle, with thinning of the myocardium of the right atrium and ventricle; the thickness ratio of the right ventricle to the left is 1:5. The lungs are grayish-green in color, soft in consistency, with dense bloody fluid oozing from the cut surface. The liver is colored yellowish-gray, with sharp edges. A pellet from an air gun was found within the parenchyma of the right lobe of the liver near the gallbladder. It is a lead pellet with a rounded head, diabolo type, caliber 4.5 mm. No significant pathological changes were observed around the bullet, indicating regenerative processes surrounding the injury, which occurred much earlier.

The edges of the spleen are sharp, reddish-gray in color, with moderate pulp scratches. The kidneys are bean-shaped, with a fibrous capsule that is easily removable; the boundary between the cortical and medullary substances is preserved, and the cortical substance is colored pale gray. The stomach contains a small amount of food mass, with a rugose mucous membrane of pale gray color.

Fig. 13. Old bullet wound of the liver caused by a pneumatic weapon. Dog

Forensic veterinary examination revealed that the cause of death in the dog was traumatic shock leading to cardiovascular failure, resulting from a penetrating gunshot injury to the abdominal wall. The entry gunshot wounds were localized on the right side of the caudal abdomen. The wound channels traversed through the subcutaneous tissue and transversely striated muscles into the abdominal cavity. The exit gunshot wound, in the form of an extensive lacerated skin injury, was located on the left side of the caudal abdomen. Additionally, gunshot injuries to the skin and muscles of the left pelvic limb were found in the region of the hip joint due to the trajectory of the bullets after exiting the abdominal cavity. These injuries occurred from a gunshot fired from a short distance shortly before death and exhibit signs of severe physical trauma, being causally linked to death. The pneumatic injury to the liver at the time of the inflicted gunshot injury had little significance in the pathogenesis and thanatogenesis.

The conclusion of the forensic veterinary examination in criminal case No. XXXXXX41450000114 dated 30.05.2023 for signs of a criminal offense under Part 1 of Article 299 of the Criminal Code of Ukraine.

From the resolution of the investigator, it is known that on on May 25, 2023, at 23:20 in the village of Lany, Lviv region, on the territory of the farm, an unknown person shot a German Shepherd dog with a traumatic weapon, resulting in the animal's death.

During the external examination of the carcass of a mixed-breed European Shepherd male dog, aged 1 year and 6 months, it was found that

the post-mortem cooling was moderate, and rigor mortis was weakly expressed. Visible mucous membranes had a bluish tint. On the skin of the neck, on the right side, behind the lower jaw, an entry gunshot wound of elongated oval shape was found, measuring 1.3 cm in length and 1.1 cm in width, with tissue defects and a surrounding abrasion belt, localized along the inner edge of the entry gunshot wound. In the soft tissues of the neck, along the trajectory of the gunshot wound, there were pronounced hemorrhages and small oval-shaped openings. Fractures of the laryngeal cartilages, necrotic changes in the muscle and connective tissue elements of the larynx, as well as traumatic injuries to the epiglottis, were noted. Additionally, comminuted fractures of the branches of the hyoid bone were found. Soft tissues in the neck area were crepitating due to gas accumulation. The gunshot wound channel traversed the throat and ended blindly on the left side of the neck. In the wall of the throat, as well as in the soft tissues of the neck, fragments of various sizes and shapes resembling projectiles from firearms were found.

In the lungs, acute congestive hyperemia and edema were observed, with areas of emphysema. The right atrium and ventricle of the heart were dilated and filled with blood. The ratio of the thickness of the left and right ventricles was 1:4. The myocardium was inconsistently colored and somewhat flaccid in consistency. The liver had a flabby consistency, with a moderate amount of blood draining from its cut surface. The fibrous capsule of the kidneys was easily removed, and the boundary between the cortical and medullary substances was clear. The stomach contained food masses, the small intestine contained chyme, and the large intestine contained formed feces. The mucous membrane of the stomach and small intestine was slightly pale, smooth, and shiny. The brain appeared natural, with grooves surrounding convolutions. The vessels of the brain were moderately filled with blood. The brain was slightly moist, and the section pattern of the brain hemispheres was natural. A small amount of transparent yellowish fluid was present in the lateral ventricles of the brain.

Forensic veterinary examination revealed that the cause of death of the dog was acute respiratory and cardiovascular failure due to a gunshot wound to the neck, accompanied by severe damage to the larynx. The entry gunshot wound was located on the right side of the neck, and the gunshot wound channel passed through the soft tissues of the neck and throat, ending blindly in the soft tissues of the left side of the neck. The wounds found in the neck area caused by gunshot fragment penetrating injuries were classified as severe physical injuries and were directly causally related to the fact of death.

The conclusion of the forensic veterinary examination in criminal case No. XXXXX41390000551 dated August 01, 2022, based on the signs of a criminal offense stipulated by Part 1 of Article 345 of the Criminal Code of Ukraine.

From the resolution of the investigator, it is known that on July 31, 2022, a report was received at the Lviv City Police Department from a police officer. In the report, the officer informed that on July 31, 2022, at approximately 17:50, while performing his official duties at the Main Railway Station of Lviv, at 1 Dvirtseva Square, a citizen N. made a threat of violence against him, unleashing a dog to attack. Upon examination of the scene, the carcass of a black-and-tan-colored dog was found and seized, which had a wound in the form of a hole in the thoracic region of the spine and in the chest area.

Radiographic examination revealed traumatic soft tissue damage in the thoracic region of the dog's skeletal system, with no foreign objects found in the body (Fig. 14).

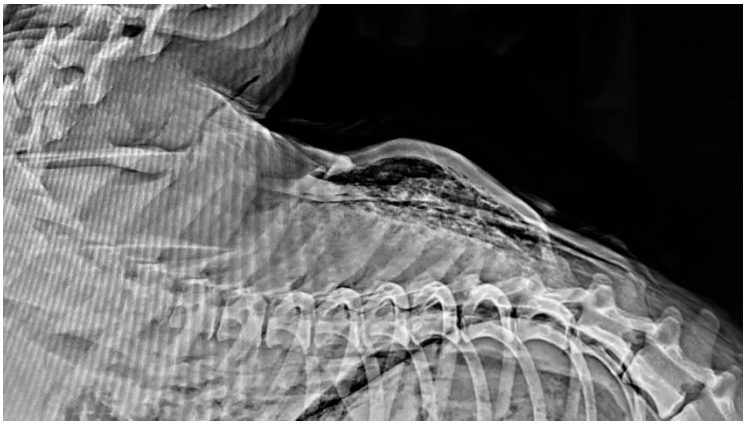

Fig. 14. Skin, subcutaneous tissue, and muscle detachment in the thoracic region of the spine. Dog. Roentgenogram

The corpse of a dog, black-and-tan in color, is well-fed. Upon external examination of the dog's carcass, in the thoracic region of the spine, slightly to the right side, an oval-shaped entry gunshot wound with a diameter of 8 mm was found, with pronounced tissue defects. The fur around the entry gunshot wound is inverted inward. The edges of the entry gunshot wound contain a narrow black-brownish rim (abrasion collar). Massive hemorrhaging is observed in the subcutaneous tissue and muscles around the entry gunshot wound.

Fig. 15. Massive hemorrhaging around the entry gunshot wound. Dog

The bullet entered between the 5th and 6th rib into the thoracic cavity. The wound channel was straight, passing through the skin, subcutaneous tissue, intercostal muscles, thoracic cavity, affecting both right and left lungs, injuring the pericardium and the heart (left atrium and left ventricle). Along the trajectory of the penetrating bullet, tissue destruction of both right and left lungs, extensive hemorrhaging, and necrotic changes were noted, as well as significant necrotic changes in the myocardium. Transmural penetrating injury was noted in the left atrium, and at the apex of the left ventricle, a significant tissue defect was observed at the site of bullet exit (Fig. 16), which further disrupted the intercostal muscles on the left at the 6–7 intercostal space.

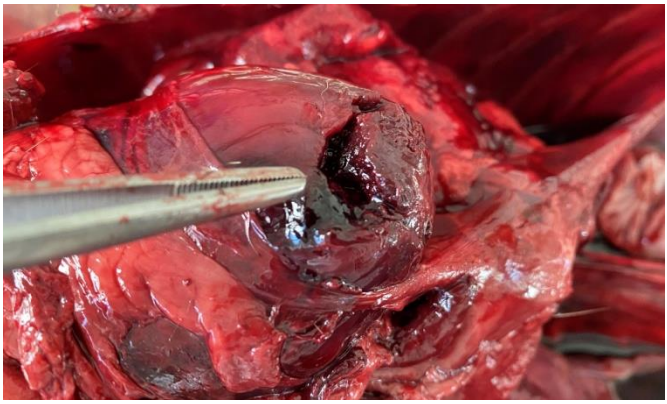

Fig. 16. Penetrating bullet injury to the heart. Dog

A significant amount of clotted blood accumulated in the thoracic cavity due to lung and heart destruction. The exit gunshot wound was located in the left lateral thoracic region, slightly to the left of center, and was slit-shaped, with the skin edges at the bullet exit site turned outward.

The liver was pale brown in color, with sharp edges. The spleen was pale pink, with slightly sharpened edges. The kidneys were bean-shaped, with a fibrous capsule that was easily removed, the medulla was pale pink, and the cortex was pale brown. The stomach and intestines were filled with food masses. A moderate amount of chyme was found in the small intestine, and formed fecal masses were found in the large intestine. Slight hemorrhaging was observed slightly to the right side in the subcutaneous tissue below the jaw, likely resulting from a blunt force trauma. Examination of the brain revealed hyperemia of the meninges and brain substance.

Forensic veterinary examination determined that the cause of death of the dog was traumatic shock, acute heart failure due to transmural gunshot wound to the chest causing traumatic damage to the heart and lungs. The direction of the bullet trajectory was from top to bottom, right to left, obliquely. The mentioned bodily injuries occurred antemortem, shortly before the time of death as a result of the action of a hard blunt object, characteristics of which are possessed by a bullet from a firearm. The identified gunshot injuries constitute severe bodily injuries and are directly causally linked to death.

CONCLUSIONS

Therefore, the use of powerful pneumatic weapons with a 4.5 mm caliber bullet leads to severe mechanical injuries, namely penetrating blind gunshot wounds, shock, acute bleeding with the development of post-hemorrhagic anemia, resulting from damage to the organs of the thoracic and abdominal cavities, with fatal consequences for the animals. The injuries identified from a pathomorphological perspective were quite variable and depended primarily on the initial velocity, bullet caliber, firing distance, as well as the part of the body hit or traversed by the projectile from the pneumatic weapon. Such injuries belong to severe bodily injuries and are causally linked to death. In contrast, old gunshot wounds to the chest of a cat and an old liver injury in a dog can be classified as minor bodily injuries.

Firearm injuries were characterized by transfixing penetrating wounds of the thoracic, abdominal wall, and other parts of the body, with a characteristic shape of the entrance wound of the wound channel, relatively even folded edges, tissue defect (abrasion ring), a border, 1–3 mm wide, red-brown color and a dark strip located along the edge of the entrance hole. In most cases, the wound channel traversed several anatomical structures

and was straight. The exit firearm orifice had an irregular star-shaped (scalloped or punched-out abrasion collar), slit-like form, with outwardly turned edges. The identified injuries were classified as severe bodily injuries directly causally related to death.

SUMMARY

Gunshot wounds in animals can result from the use of both firearms and pneumatic weapons. A bullet from a firearm possesses significant kinetic energy, which, upon impact with the animal's body, exerts mechanical force, leading to the disruption of the integrity of anatomical structures, the development of traumatic shock, blood loss, and ultimately the death of the animal. Conversely, a projectile discharged from a pneumatic weapon (rifle), despite the small mass and size of the bullet, can also cause severe injuries that may result in the death of the animal.

The article presents the results of forensic veterinary examinations conducted at the Department of Normal and Pathological Morphology and Forensic Veterinary Medicine at Stepan Gzhytskyi National University of Veterinary Medicine and Biotechnologies of Lviv during the period from 2022 to 2024. An assessment of firearm and airarm injuries in dogs and cats is provided, based on a comprehensive analysis of the characteristics of the injuring agent, morphological features of the injury site, projectile penetration depth, distance and angle of fire, number and type of injuries, nature of wound channels, and degree of tissue and organ destruction. The scientifically substantiated approach to the study of firearm (bullet, shot) and pneumatic injuries included the analysis of the properties of the entrance wound, wound channel, and exit wound.

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