Opis przypadku *Case report*

Post-mortem diagnosis of gunshot injuries in an osprey: A case report

MARIUSZ Z. FELSMANN, MACIEJ GOGULSKI*

Institute of Veterinary, Faculty of Veterinary Medicine and Animal Science,
Poznań University of Life Sciences, Wołyńska 35, 60-637 Poznań, Poland
*University Centre for Veterinary Medicine, Poznań University of Life Sciences,
Szydłowska 43, 60-656 Poznań, Poland

Received 22.08.2017 *Accepted 09.01.2018*

Felsmann M. Z., Gogulski M.

Post-mortem diagnosis of gunshot injuries in an osprey: A case report

Summary

The shooting of protected species, especially rare animals, is regarded as a priority issue by law enforcement authorities. In such cases, an expert veterinarian is required not only to confirm the death of the animal as a result of shooting, but also to provide a precise description of the shot. In cases of shootings with pellet bullets, such a description is particularly difficult. The evaluation of the gunshot wounds of an osprey (Pandion haliaetus) delivered to the Veterinary Medical Centre at the University of Poznań called for the use of a variety of diagnostic techniques. A preliminary assessment confirming the shot was based on an X-ray photo. Computed tomography (CT) was used for in-depth diagnostics, providing a spatial representation of bullet stopping points and fragments. The shot caused a lower leg bone fracture. This damage upset the anatomical structure of the animal's limb, which made it impossible to establish the wound channel by CT. Therefore, full shot characteristics could only be made only after a classical post-mortem examination. This examination facilitated the use of modern imaging diagnostic techniques. The use of mixed diagnostic techniques enabled us to determine the number of shots, the type of ammunition used and the direction from which the shot was fired. On the one hand, this case illustrates the possibilities offered by modern imaging diagnostic techniques and, on the other hand, it shows that the classic post-mortem examination remains a primary diagnostic tool for veterinary forensic experts. This is especially important when preparing forensic veterinary opinions in high-priority law enforcement cases.

Keywords: osprey, shot, veterinary expert opinion

Clawed birds are still considered by many people as pests (12, 23, 29). Hostility towards these animals is most frequently observed among fish farmers and hunters. Although it is well-known in Poland that these birds are protected species, they are often shot, either by accident or with the intent to kill (1, 8, 12, 23).

A case of an animal having been killed in infringement of Animal Protection Laws, including in particular the Endangered Species Act, requires the law enforcement authorities to take appropriate action to punish the perpetrators. The number of birds killed illegally by small-arms owners is not known, but every such killing is an irremediable loss for nature. In the case of the rarest birds, the loss of even one breeding pair can threaten the survival of their population in the region or even the whole country.

In view of the above threat, it is necessary to make every effort to disclose and punish perpetrators of these criminal acts. In such cases, the opinion of an expert veterinarian is considered vital evidence for the law enforcement authorities and courts. Veterinarians, even those serving as expert witnesses, do not often encounter animal gunshot wounds. Therefore, they must have the skills to properly assess gunshot wounds, which determines the relevance of their assessment for the investigation (2, 5, 11-13, 22, 26).

It is not difficult for a veterinarian to recognize a gunshot wound, but it is much more difficult to determine the facts of the crime, including the direction from which the animal was shot.

Animal corpses are often placed on section tables without additional information on the location and circumstances of the shooting. Hence, veterinary surgeons often find it difficult to provide a clear description of the case for the purpose of court proceedings, especially where birds are concerned.

Fig. 1. A – pellet under the skin of the osprey; B – Main elements of left tibia damaged by shot; C – reconstructed tibia with visible impact point

The latest diagnostic techniques, despite their many advantages, do not always yield unambiguous findings regarding the shot. The present study, based on the case of an osprey (*Pandion haliaetus*), deals with the use of all diagnostic techniques available in anatomic pathology to describe cases of small-arms shootings.

Case report

The corps of a common osprey found in a water reservoirs in Wielkopolska Voivodeship was delivered to the Veterinary Medical Centre at the University of Poznań in June 2016. After a preliminary examination, a discontinuity of the skin on the outer side of the bird's left leg and a small metal ball (pellet) just below the skin on the inside of the distal left forearm were found (Fig. 1A). Following the preliminary examination of the body of the animal, an X-ray was taken, which showed a number of pathological shadings of various contours, most closely resembling circles (Fig. 2). The discontinuity of the skin and the metal ball along with the shadows visible on the X-ray made it plausible that the bird had been shot with a smooth-bore weapon. Owing to the imaging limitations of this technique (the image is flat and two-dimensional), the X-ray image analysis could not precisely locate individual shading elements in the bird's body. It was possible, however, to locate the projectiles and their fragments in the area of the lower right leg and the left front ribs (Fig. 2).

A careful analysis of the X-ray image also revealed multiple fractures of the left leg (Fig. 2), which was confirmed by palpation. The presence of strongly shaded elements in the immediate vicinity of bone fragments led to the preliminary diagnosis that the fracture had been caused by a gunshot.

In-depth diagnostic imaging was performed by Cone Beam Computed Tomography (CBCT) using a FIDEX scanner (by Animage, www.animage.com) with a display field of view of 15 cm and a plate thickness of 0.29 mm"] (Fig. 3).

Images obtained by computed tomography (CT) made it possible to determine the location of individual high-density objects and their shape (Fig. 3). This study was sufficient to identify the objects as lead pellets identical to those fired from smooth-bore weapons. It was found that three smaller shadings located in the rump and left shoulder were pellets from No. 6 cartridges and four other elements visible near the fracture and left front ribs were fragments of one pellet. It was assumed that this single pellet from a No. 4 cartridge had disintegrated most likely after hitting the lower leg bone.

The results of advanced imaging techniques (CT) made it possible to uniquely locate the pellets and their fragments in the bird's body and suggested that the bird had been shot at least twice. At this point, it should be noted that private

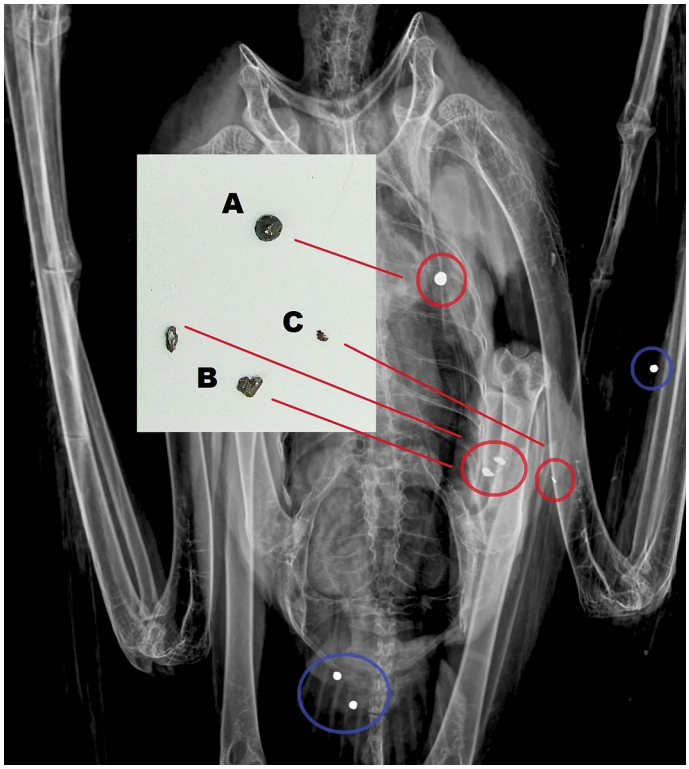

Fig. 2. X-ray photo with visible bullets. A, B and C – elements of pellet after defragmentation (after hitting the lower leg)

manufacture of cartridges is not difficult, so it is possible to use a cartridge containing pellets of various sizes. On the other hand, users of small arms know that such cartridges have significantly worse ballistic properties.

In this case, the State Hunting Guard was eager to acquire the bullets from the bird's body and to determine the direction from which they were fired. Although obtaining the bullets after the imaging studies did not pose any difficulty, it was impossible to determine the direction from which shots were fired on the basis of the preliminary examinations, X-ray images and CT tests.

The fractured lower leg bone was of decisive importance for settling this issue. Both the X-ray images as well as the spatial CT images were taken from an animal whose anatomy had been severely disturbed. The movement of soft tissue after the fracture, which had occurred several times by the time of the examination at the Centre, made it impossible to trace the direction of the wound channel from its inlet into soft tissue.

In order to establish the direction of the wound channel, it was necessary to extract the lower left leg bones and to examine them thoroughly. Only by examining the damage to these bones and reconstructing their position in flight relative to the body and the inlet wound was it possible to determine the direction of the shot. Fig. 1B and 1C show the osprey's extracted bones. Fig 1B presents fragments of the lower left leg after the pellet smashed the shin bone, and Fig 1C shows the shin bone after reconstruction. The damage revealed indicates the impact of low kinetic energy

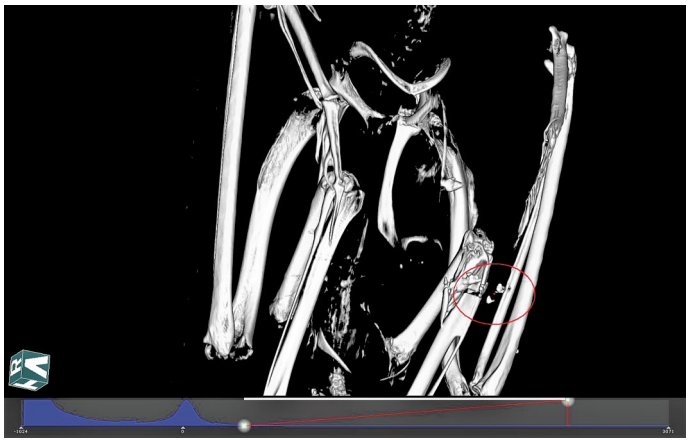

Fig. 3. Photo from a computer tomography with visible pellets and bones

Fig. 4. Changes in bone tissue characteristic for bullet impact

(lead) bullets. One of the walls of the tibia was destroyed, and as a result the bullet disintegrated. Three of the smaller fragments of the pellet stopped in the soft tissue near the bone, while the largest fragment moved near the front of the chest. The changes in bone tissue characteristic of bullet impact are presented in Fig. 4. Their alignment, along with the position of the inlet wound, made it possible to determine the direction of the shot and the position of the bird's limb at the time of the hit. On the basis of the information obtained from all auxiliary investigations and the post-mortem examination, it was concluded that the osprey had been shot during free flight from the bottom left side. The State Hunting Guard secured the pellet extracted from the bird's body for isotopic analysis, and the medical\veterinary opinion became important evidence in the investigation.

Discussion and conclusions

This case clearly demonstrates that modern imaging techniques are an excellent diagnostic tool in the work of veterinary experts. X-ray images (2, 5, 6, 9, 14, 22) remain the primary tool for a veterinarian who assesses gunshot wounds. It makes it possible to exclude a gunshot when anatomopathological changes observed during an external visual examination of the animal suggest such an eventuality (17). The availability of a CT scanner in many cases greatly facilitates the work of veterinarians, allowing them to locate bullets and their fragments without the need for a post-mortem examination (2, 3, 5, 10, 20, 31). Contemporary technology makes it possible to diagnose cases of animals having being shot even when there are no bullets or pellets in the body or when the animal's body has been destroyed (e.g. burnt); We are able to detect microscopic fragments (residue) of bullets with masses measured in nanograms (3, 4, 6, 15, 19, 24, 27). Despite the possibilities provided by modern imaging diagnostics and residue detection techniques, one must not forget their limitations (7, 9, 16, 21, 30). When investigating cases of animals shot with small arms, experimental testing and gunshot models may also be used, but these tests and models should be used with caution, as they are unable to reproduce actual shots (13, 18, 25, 28).

It should be noted that traditional methods, in particular detailed post-mortem examinations, remain an important and often irreplaceable tool in the diagnosis of animal gunshot wounds (5, 9, 16, 22).

It is important to always bear in mind that every animal gunshot wound is individual and unique. Each such case should be examined with due care and by all available diagnostic methods.

References

1. Act of 21 August 1997 on animal protection. (Dz. U. 1997 No. 111, item 724). http://isap.sejm.gov.pl/DetailsServlet?id=WDU19971110724.
2. *Alvis-Miranda H. R., Rubiano A. M., Agrawal A., Rojas A., Moscote-Salazar L. R., Satyarthee G. D., Calderon-Miranda W. G., Hernandez N. E., Zabaleta-Churio N.*: Craniocerebral Gunshot Injuries: A Review of the Current Literature. Bull. Emerg. Trauma. 2016, 4, 65-74.
3. *Amadasi A., Borgonovo S., Brandone A., Di Giancamillo M., Cattaneo C.*: The survival of metallic residues from gunshot wounds in cremated bone:

a radiological study. Int. J. Legal Med. 2012, 126, 3639. DOI: 10.1007/s00414-011-0633-y.
4. *Amadasi A., Brandone A., Rizzi A., Mazzarelli D., Cattaneo C.*: The survival of metallic residues from gunshot wounds in cremated bone: a SEM-EDX study. Int. J. Legal. Med. DOI 10.1007/s00414-011-0661-7.
5. *Bradley-Siemens N., Brower A. I.*: Veterinary Forensics: Firearms and Investigation of Projectile Injury. Vet. Pathol. 2016, 53, 988-1000.
6. *Brożek-Mucha Z.*: Chemical and physical characterisation of welding fume particles for distinguishing from gunshot residue. Forensic Sci. Int. 2015, 254, 51-58.
7. *Budzik G., Turek P.*: Proces rekonstrukcji obrazów tomograficznych. Probl. Nauk Stosow. 2016, 4, 057-064.
8. Council Directive of 2 April 1979 on the conservation of wild birds (79/409/EEC). Dz. Urz. L 103, 25/04/1979 P. 0001-0018.
9. *Cavalcanti A. G., Krambeck R., Araujo A., Manes C. H., Favorito L. A.*: Penile lesion from gunshot wound: a 43 case experience. Int. braz. j. urol. 2006, 32. http://dx.doi.org/10.1590/S16775382006000100009.
10. *Doan N., Patel M., Nguyen H. S., Montoure A., Shabani S., Gelsomino M., Janich K., Mueller W.*: A rare remarkable recovery in a pediatric patient with the bihemispheric, transventricular trajectory craniocerebral gunshot wound. J. Surg. Case. Rep. 2016: rjw076. DOI: 10.1093/jscr/rjw076.
11. *Felsmann M. Z., Felsmann M., Szarek J., Babińska I.*: A review of firearms, projectile and gunshot wounds in animals. Pak. Vet. J. 2014, 34, 279-287.
12. *Felsmann M. Z., Szarek J.*: Waterfowl hunting in the context of lead contamination and ethically non-conforming conduct. J. Elem. 2015, 20, 785-796.
13. *Felsmann M. Z., Szarek J., Felsmann M., Babińska I.*: Factors affecting cavity temporary generation during gunshot wound formation in animals – new aspects in the light of flow mechanics: a review. Veterinarni Medicina, Vet. Med.-Czech. 2012, 57, 569-574.
14. *Genç A., Usseli M. I., Pamir M. N.*: When the bullet moves! Surgical caveats from a migrant intraspinal bullet. Neurol. Neurochir. Pol. 2016, (http://dx.doi.org/10.1016/j.pjnns.2016.06.006).
15. *Gradašèeviæ A., Resiæ E., Sarajliæ N., Franjiæ B., Salkiæ A., Džuzdanoviæ-Pašaliæ A.*: Is it possible to determine firearm calibre and shooting range from the examination of gunshot residue in close range gunshot wounds? An experimental study. Journal of Health Sciences 2013, 3, 232-237.
16. *Hejna P., Pleskot J.*: Shotgun Injury – Multiple Pellets. Soud. Lék. 2009, 54, 8-14.
17. *Hejna P., Zátopková L., Šafr M., Straka L.*: Circular Saw-Associated Fatality Mimicking Gunshot Injury. J. Forensic Sci. 2013, 58, No. S1. DOI: 10.1111/1556-4029.12027.
18. *Humphrey C., Kumaratilake J.*: Ballistics and anatomical modelling – A review. Leg. Med. 2016, 23, 21-29.
19. *Kollander B., Widemo F., Ågren E., Larsen E. H., Loeschner K.*: Detection of lead nanoparticles in game meat by single particle ICP-MS following use of lead-containing bullets. Anal. Bioanal. Chem. 2016, 409, 1877-1885.
20. *Lichte P., Oberbeck R., Binnebösel M., Wildenauer R., Pape H. C., Kobbe P.*: A civilian perspective on ballistic trauma and gunshot injuries. Scand. J. Trauma Resusc. Emerg. Med. 2010, 18, 35, DOI: 10.1186/175772411835
21. *Lindstro A.-C., Hoogewerff J., Athens J., Obertova Z., Duncan W., Waddell N., Kieser J.*: Gunshot residue preservation in seawater. Forensic Sci. Int. 2015, 253, 103-111.
22. *Listos P., Komsta R., Łopuszyński W., Gryzińska M., Teresiński G., Chagowski W., Buszewicz G., Dylewska M.*: Radiological and forensic veterinary analysis of gunshot cases in eastern Poland. Med. Weter. 2016, 72, 453-457. DOI: 10.21521/mw.5531.
23. *Mitrus C., Zbyryt A.*: Wpływ polowań na ptaki i sposoby ograniczania ich negatywnego oddziaływania. Ornis Polonica 2015, 56, 309-327.
24. *Poppa P., Porta D., Gibelli D., Mazzucchi A., Brandone A., Grandi M., Cattaneo C.*: Detection of Blunt, Sharp Force and Gunshot Lesions on Burnt Remains. Am. J. Forensic Med. Pathol. 2011, 32, 275Y279.
25. *Rutty G., Boyce P., Robinson C., Jeffery A., Morgan B.*: The role of computed tomography in terminal ballistic analysis. Int. J. Legal Med. 2008, 122, 1-5.
26. *Stefanopoulos P. K., Pinialidis D. E., Hadjigeorgiou G. F., Filippakis K. N.*: Wound ballistics 101: the mechanisms of soft tissue wounding by bullets. Eur. J. Trauma Emerg. Surg. DOI 10.1007/s00068-015-0581-1.
27. *Taudte R. V., Beavis A., Blanes L., Cole N., Doble P., Roux C.*: Detection of Gunshot Residues Using Mass Spectrometry. Biomed. Res. Int. 2014; 965403. DOI: 10.1155/2014/965403.
28. *Thali M. J., Kneubuehl B. P., Zollinger U., Dirnhofer R.*: The "skin-skull-brain model": a new instrument for the study of gunshot effects. Forensic Sci. Int. 2002, 125, 178-189.
29. *Thompson P. S., Douglas D. J. T., Hoccom D. G., Knott J., Roos S., Wilson J. D.*: Environmental impacts of high-output driven shooting of Red Grouse Lagopus lagopus scotica. Ibis. 2016, 158, 446-452.
30. *Tillman W. L.*: Automated gunshot residue particle search and characterization. J. Forensic Sci. 1987, 32, 6271.
31. *Yaralanmalar K. A.*: Gunshot Injuries Due to Celebratory Gun Shootings. Turk. Neurosurg. 2009, 19, 73-76.

Corresponding author: Mariusz Z. Felsmann DVM, PhD, Wołyńska 35, 60-637 Poznań, Poland; e-mail: felsmann.mariusz@wp.pl