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Short Communication

Bone and Brain Lesions in Horses Following Euthanasia with Fire Gun

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Abstract

Fire gun euthanasia is a widely used method on Equine Infectious Anemia positive horses in Brazil. Death occurs by massive destruction of brain tissue and the degree of damage depends on the gun, projectile, and shooting precision. Cranial bone lesions of eight horses euthanized and brain lesions on two of those animals were evaluated. This study aimed to verify the applicability and efficiency of the method and to check the lesions features, with emphasis on fatal ones, found mainly in frontal, sphenoid and occipital bones, and on cerebral hemispheres, thalamus, hypothalamus, and brain stem. Difficulties in applying the method for grouped animals were identified. Injuries that caused immediate stunning were related to only one shot and the gun and ammunition used were effective for the purpose.
Key Words: brain, skull bones, fire gun euthanasia, forensic ballistic.

Introduction

Euthanasia is considered by the Federal Council of Veterinary Medicine (FCVM) as a humanitarian method to take an animal's life, recommended when there is a threat to the animal welfare or to public health (3).

Equine euthanasia by fire gunshot is an acceptable method, under restrictions, applied when other methods are unavailable or impracticable, required in some field situations, or when the animal suffering justifies the immediate death. The technique must be performed by a trained qualified person, under supervision of a veterinarian and avoiding the presence of spectators (1, 2, 3, 5). When possible, euthanasia must be accomplished by a police officer or a qualified person for the use of fire guns. If correctly used, the method guarantees immediate death of the animal with absence of suffering. The projectile must be thrown towards the animal head in order to produce irreversible brain lesions and death, since thoracic or abdominal lesions may not produce immediate death and, as a consequence, suffering and pain may arise. Its use must be avoided in situations where the animals are not adequately restrained, due to the higher risk of accidents, or the necessity of more than one projectile (4).

The animal's adequate restraint is essential and the gun must be placed at a position necessary to assure significant brain damage, promoting the immediate loss of consciousness. Among the disadvantages of the method are the difficulty of restraint in field situations; destruction of brain tissue, which makes some post mortem exams not feasible; to be visually not pleasant; and risk to the operator and observers (5, 10). The gun, as well the license, must be legalized, the procedure must be performed at an open environment, and the caliber must be compatible with the specimens to be euthanized (5).

In Brazil, the option by fire gun shooting as a euthanasia method is ordinary for equines positive for Equine Infectious Anemia (EIA). The mentioned disease

is a cosmopolitan infection that affects equines, caused by a RNA Lentivirus, Retrovirus. Once installed in the animal body, the virus remains through its whole life, even when there are no clinical signs. It is an essentially chronic disease, however it can appear in hyperacute, acute and subacute forms. The infected horses may show fever, punctiform hemorrhages under the tongue, anemia, abdominal swelling, anorexia, depression and nasal bleeding. The disease also affects donkeys, asses and mules.

The transmission occurs through horse-fly and stable-fly bites; contaminated material with infected blood, like needles, surgical instruments, dental gross, esophageal probe, hoof clips, gears, spurs, and other materials, in addition to placenta and colostrum; and through breeding. As prevention, any positive animal to agar gel immunodiffusion (AGID), approved to EIA diagnosis, must be isolated and further euthanized, once it is considered a disease spreader. There is no effective treatment or vaccine for this disease. The infected animal becomes a permanent carrier of the disease, being a potential source of infection. The evidence of any positive equine for EIA must be reported to the Farm Defense Agency (9). When the recommended measure is the sanitary slaughter (euthanasia) of the carrier animal, it must be performed by the official veterinary service, at a maximum time of thirty days, starting from the test result, preferably on the property where the animal is housed (7). The fire gun method of euthanasia is chosen due to difficulties of acquiring anesthetic drugs and because of its recommendation to be performed at the property of origin of the animals (5).

Forensic ballistic analyzes alterations produced by fire gun projectiles. The entrance wounds arising from distant shots show borders turned to inside, due to the bruising action of the wound borders, which, acting outside to inside, makes it reversed. The differential diagnosis between the entrance and exit wounds at the bone level, mainly in cranial bones, is done through the Bonnet funnel sign or Pousold truncated cone (Toschetto, 1999)(10).

At the outer lamina of the bone, the entrance wound is round, regular, and with a punch shape. At the inner lamina, the wound is irregular, wider than of outer lamina, and with a well-defined inner bevel, giving the perforation the shape of a funnel or cone trunk. The exit wound is exactly the opposite, like a wide outer bevel, repeating the cone trunk shape, but with the base turned to outside. In middle distance shots, the shape is similar to the entrance of long-distance shots, with the characteristic of a halo or tattoo zone because of the unburned gunpowder grains and by the coating with metal particles. Short distance shots show a zone of smoking, produced by the grime deriving from the gunpowder burn, while close-range shots show a zone of skin and hair scorching around the entrance wound (10).

A few data are available on the literature concerning the characteristics of fire gun lesions in euthanasia procedures, as well as about the effectiveness of its results for the success of the method. Thus, and based on the wide use of the method in Brazil, this work aimed to identify and to characterize the lesions arising from fire gun euthanasia in horses and their relation with the efficacy of the procedure.

Material and Methods

The data of eight animals, four horses and four mules, were considered. The animals were euthanized by fire gun shooting on the head, in Araguaína city, North of Tocantins State, Brazil. A .22 caliber rifle with warhead projectiles was used. All the shots were accomplished by the same person, a police officer appointed by the Farm Defense Agency of Tocantins, at an approximate distance of 1.5 m. The animals came from the same raiser and a veterinarian recommended the euthanasia after EIA diagnosis. They were slaughtered one by one in a grave measuring 6x3x3 m, were they were burned afterwards.

The reference for the entrance of the projectile in the head was determined as 2.5 cm over the intersection of straight imaginary lines traced between the center of the ear base and the medial contralateral palpebral commissure, which formed an "X" on the dorsal surface of the animal's head, as recommended by national and international organs for this method of euthanasia in this species (5, 8). The executer tried to angulate the fire gun with the neckline, with the aim of not transfixing the animal, but only the brain, embedding the projectile in vertebral column or other cervical tissues (6, 8). The analysis of the lesions caused by the shots was performed through observation of the effects of tissue damage. The entrance and exit wounds of the projectiles, as well as the brain parts and the other affected regions, were analyzed. The heads were macerated in water for the analysis of bone lesions and the brain of two animals was removed previously to the maceration for the evaluation of the lesions on the organ.

Results and Discussion

Only three out of the eight euthanized animals received one lethal shot. Two animals received two shots each, another two received three shots each, and one animal received four shots (Table 1). The unsuccessful immediate stunning at the first shot for the majority of the animals, was due especially to three factors, in accordance with the postulated by some authors (6), and national (4) and international (8) official councils: difficulty of an adequate restraint inside the grave, presence of other animals, and inexperience of the executer of the task. Because of restraint difficulties, no shot was performed exactly on the mean surface, but very close, at least if the entrance point of the projectile was considered. All shots caused lesions characterized by small holes of entrance on the skin (Figure 1), which measured among 2 and 3 cm

diameter, and halos of hematoma with signs of carbonized subcutaneous tissue, with 2 to 3 cm diameter (Figure 2).

Table 1. Distribution of numbers of projectiles by animal and species, out of eight equidae euthanized by fire gun in Araguaína, Tocantins, Brazil.

Animal (by order of euthanasia)	Species	Number of projectiles used to cause death
1	Mule	2
2	Horse	2
3	Horse	3
4	Mule	1
5	Horse	1
6	Horse	1
7	Mule	3
8	Mule	4

Figure 1. Horse, head; dorsal view. Animal euthanized by 03 gunshots. Note the entrance wounds (0.3-0.6 mm/diameter) (arrows) on the skin of the frontal region of the head, between the orbits. Legend: LSM – left supraorbital margin; RSM – right supraorbital margin..

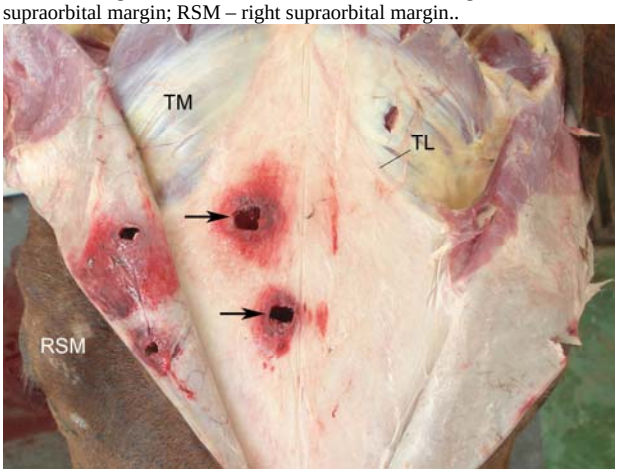

Figure 2. Horse, head with its frontal region skin reflected; dorsal view. Animal euthanized by 02 gunshots. Entrance wounds (arrows) and surrounding haematomas (2.0-3.0 cm/diameter) on the subcutaneous tissue. Legend: RSM – right supraorbital margin; TL – temporal line; TM – temporal muscle.

On the bone surface, the entrance holes showed round to oval contour and were observed on frontal and nasal bones, measuring 0.5 to 1 cm diameter (Figure 3). Bonnet signs, characterized by an entrance hole with a shape of a funnel with a large base turned to inside, and Benassi signs, characterized by the presence of a dark color around the holes, due to impregnation with projectile gunpowder or lead, were found accordingly with its description by Toschetto (1999) (10). The projectile exit holes were always wider than the entrance holes, with around 3 to 6 cm diameter and with bone fragments on the contiguous tissue, observed chiefly on the cranial base due to intense fracture of basisphenoid and basiocciptal bones (Figure 4). The shots located under the recommended place penetrated caudally in nasal bones or in a more rostral part of frontal bones, reaching frontal paranasal sinus, rostrally to the cranial cavity, thus not leading to an immediate death. Such shots had their place of exit rostrally to the cranial base, mainly by the choanas, reaching at a higher or lower degree, depending on the angle of the projectile trajectory, ethmoid, vomer, pterigoid and palatinum bones, and ethmoidal nasal conchas; one animal showed damage at the caudal extremity of dorsal and ventral nasal conchas. In one case, the projectile exit occurred through the medial wall of the right orbit (Figure 5), between the orbital part of the frontal bone and the wing of sphenoid bone, reaching the orbital cavity, where one of the projectiles and fragments of another were placed. Skin exit holes were not observed in any animal, which indicates that, although some shots were not lethal, there were not splinters, therefore guaranteeing the security of the area for this aspect.

Figure 3. Mule, skull, 04 gunshots; dorsal view. Entrance holes between middle and rostral thirds of the frontal bone. Note that one of the holes is located exactly on the median plane, and the other three on the right (one exactly on the nasofrontal suture). Legend: F= frontal bone; N= nasal bone. Bar: 5 cm.

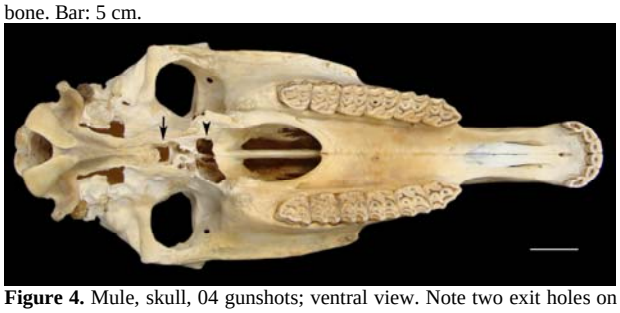

Figure 4. Mule, skull, 04 gunshots; ventral view. Note two exit holes on the base of the skull. The caudal hole (black arrow) is located between basisphenoid and basioccipital bones, and the rostral hole (arrowhead) includes damage on the vomer (wings), both palatine (perpendicular lamina), and both pterygoid bones. Bar: 5 cm.

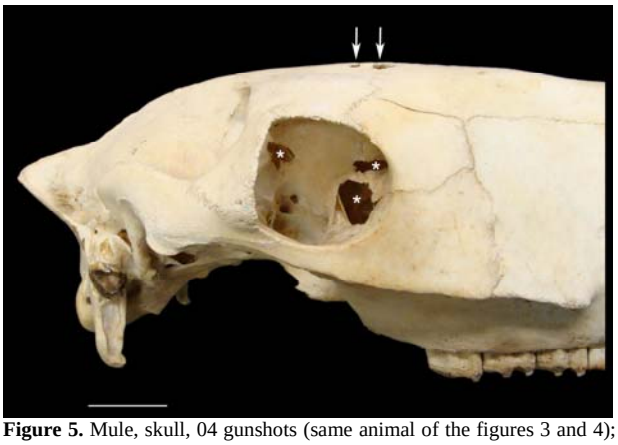

Figure 5. Mule, skull, 04 gunshots (same animal of the figures 3 and 4); lateral view of the right bony orbit. Note the two most lateral entrance holes (arrows) on the surface of the frontal region of the skull; there are also three exit holes (asterisks) through the medial and rostral walls of the orbit; an extra exit hole was due to a fragmented bullet found after head maceration. Bar: 5 cm.

All animals that received more than one shot, had the fatal shot as the last and the only shot to penetrate in the cranial cavity (Figure 6); all other shots penetrate in different points, deep into the nasal cavity. An important brain lesion observed at the fatal projectile trajectory was observed on the two analyzed brains. In one case, one of the brain hemispheres was reached, mainly at frontal and temporal lobes, and there was destruction of thalamus and hypothalamus. In the other case, a lesion in all the extension of the piriform lobe was observed at the rostrocaudal direction, brain trunk, and cerebellum, which indicates that the gun inclination related to the neck line was adequate for the projectile to extensively transfix the brain, as preconized on the method recommended by Cooney and others (2012) (6) and by international official council, as National Farm Animal Care Council of Canada (8).

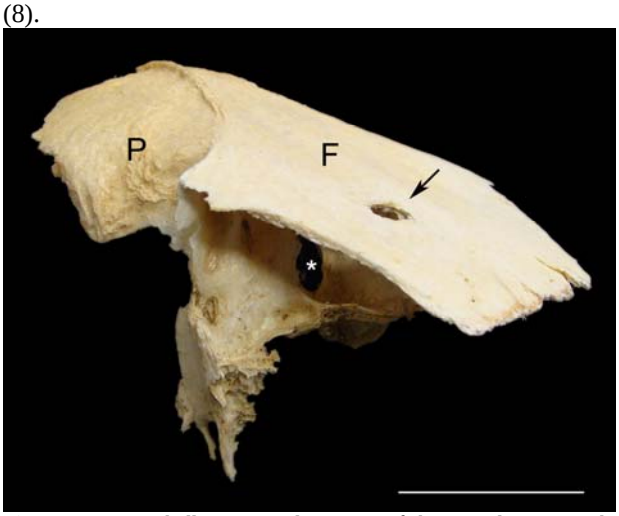

Figure 6. Horse, skull piece involving part of the cranial cavity; right dorsolateral view. Animal euthanized by a single gunshot. Note the entrance hole (arrow) on the caudal third of the frontal bone. The bullet reached out the cranial cavity through the caudal wall of the frontal sinus (asterisk), just above the region of the cribriform lamina (absent) of the ethmoid bone. Legend: F – frontal bone; P – parietal bone. Bar: 5 cm.

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