ORIGINAL ARTICLE

An evaluation of traumatic deaths associated with animal attacks: A 10-year autopsy study

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ABSTRACT

BACKGROUND: Just as throughout the world in general, deaths related to animal attacks continue to be a public health problem in Turkey. A decrease in areas of natural habitat because of human invasion, and the use of these areas for hunting, wood-cutting, recreational and sporting activities has increased the possibility of humans encountering wild animals.

METHODS: A physical retrospective screening was made of the forensic records of a total of 8944 autopsy cases in the Forensic Medicine Institute of the Trabzon Group Directorate in the 10-year period between Januarry 2007 and December 2016.

RESULTS: When the types of animals causing the traumatic death were examined, the most frequent was cattle in 15 cases followed by horses in 7 cases, bears in 4 cases, wolves in 2 cases, and wild boars in 2 cases. According to the autopsy results, the cause of death was most often intrathoracic bleeding and intrathoracic organ damage, the regions of the body injured were seen to be most often the chest and back, and the most common form of injury was blunt/crush trauma.

CONCLUSION: From these records, cases were identified where the cause of death was traumatic animal attack, and examination was made of the sociodemographic characteristics, the type of animal that caused the injuries, information about the location of the incident, witness statements, information about the healthcare centre, findings of external examination and autopsy, and the cause.

Keywords: Animal attack; autopsy; traumatic deaths.

INTRODUCTION

Just as throughout the world in general, deaths related to animal attacks continue to be a public health problem in Turkey. A total of 1943 deaths related to animals were reported in a 10-year period in the USA, and 151 were reported in a 6-year period in India.[1,2] Although there are insufficient data on injuries and deaths associated with animals in Turkey, some cases have been reported, predominantly cases involving both domestic and wild animals such as cattle, wolves, bears, wild boar, and bees.[3–7]

A decrease in areas of natural habitat because of human invasion and the use of these areas for hunting, wood cutting, recreational, and sporting activities has increased the possibility of humans encountering wild animals. Any contact with domestic or wild animals may result in the injury or death of humans and the animals.[3,8–10] The increasing human population and the parallel increase in the demand for meat and dairy products have led to an increase in livestock activities and the number of livestock. Thus, an increase in the number of people working in this field can increase the frequency of physical contact between humans and livestock.

In classifications in literature, deaths caused by animals are separated as venomous and non-venomous (traumatic). Another classification is made according to wild or domestic animals.[11,12] Venomous animal attacks may lead to poisoning

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or death in the form of anaphylactic reaction following contact of the human body with animals such as bees, scorpions or snakes.[13–15] A previous study reported that 61% of deaths associated with animals were non-venomous, and 39% were venomous, non-traumatic deaths, caused by poisoning, anaphylaxis, and sepsis.[1]

Traumatic injuries caused by animal attacks may occur in the form of crushing by body weight, striking with the head or foot, lacerations made by a horn, teeth or nails, bites, or tissue or organ amputation, depending on the breed of animal and the nature of the attack or defense at the time of the incident. As a result of these types of contact, ecchymosis, contusions, and lacerations may be seen on the skin, lacerations of internal organs and major vessels, bleeding in body cavities, and tissue loss or amputation in the extremities.[16–18]

The Eastern Black Sea and Eastern Anatolian regions of Turkey are areas where people have relatively frequent contact with some wild animals as it is a densely forested natural habitat area for these animals, where in addition to large and small-scale livestock activities, local people engage in wood cutting and hunting. The aim of this study was to evaluate the findings of autopsies conducted in our center of deaths associated with animals in this region.

MATERIALS AND METHODS

A physical retrospective screening was made of the forensic records of a total of 8944 autopsy cases in the Forensic Medicine Institute of the Trabzon Group Directorate in the 10-year period between January 2007 and December 2016. From these records, cases were identified where the cause of death was traumatic animal attack, and examination was made of the sociodemographic characteristics, the type of animal that caused the injuries, information about the location of the incident, witness statements, information about the health-care center, findings of external examination and autopsy, and the cause of death.

The study included only injuries of traumatic origin, and cases were excluded from the study if the cause of death was from venomous contact or attack.

Data obtained in the study were analyzed statistically using IBM SPSS vn. 25 software. The findings were presented in table form. The Fisher's exact test was used in statistical evaluations. $P<0.05$ was accepted as statistically significant.

RESULTS

The 32 cases included in the study comprised 26 males and six females with a mean age of 61.1±21.9 years. The most common age range was >60 years with 21 cases and there was only one case aged <10 years. The attacks occurred in open areas such as pasture or forest, far from residential areas in 21 cases, in areas close to the home such as a barn or around the house in 10 cases, and in a pond in one case.

Table 1. Characteristics of the autopsy cases

Characteristics	n	%
Gender		
Male	26	81.3
Female	6	18.7
Age (mean±SD=61.1±21.9 years)		
<10	1	3.1
10–19	1	3.1
20–29	2	6.3
30–39	2	6.3
40–49	0	0.0
50–59	5	15.6
≥60	21	65.6
Scene of the Incident		
Open area-pasture-forest	21	65.6
Barn	6	18.8
Garden or surroundings of house	4	12.5
Pond	1	3.1
Animal causing death		
Cattle	15	46.9
Horse	7	21.9
Bear	4	12.5
Wolf	2	6.3
Wild boar	2	6.3
Donkey	1	3.1
Dog	1	3.1
Nature of the animal		
Domestic/farm	24	75.0
Wild	8	25.0
Presence of witness	22	68,8
Treatment received before death	8	25.0
Cause of death		
Intrathoracic bleeding	14	43.8
Intrathoracic organ damage	13	40.6
Intra-abdominal bleeding	6	18.8
Intra-abdominal organ damage	6	18.8
Major vessel damage	4	12.5
Intracranial bleeding	9	28.1
Spinal cord damage	8	25.0
Widespread soft tissue bleeding	2	6.3
Rabies	2	6.3
Retroperitoneal bleeding	1	3.1
Cardiac arrest related to blunt chest trauma	1	3.1
Drowning	1	3.1

Table 2. Characteristics of the injuries

Characteristics	n	%
Form of injury		
Blunt trauma- crush	21	65.6
Penetration by horn or claws	9	28.1
Trampled, kicked	5	15.6
Bite	3	9.4
Falling off the animal	3	9.4
Rolling fall after attack	2	6.3
Part of the animal causing the injury	29	90.6
Foot, nail, hoof	22	68.8
Head (butting)	11	34.4
Horn	5	15.6
Claw, nail	4	12.5
Tooth	4	12.5
Injured body region		
Chest- back	20	62.5
Head	15	46.9
Neck	10	31.3
Abdomen – lower back	9	28.1
Upper extremity	4	12.5
Lower extremity	4	12.5
Pelvis	2	6.3
Perineum	1	3.1
Localisation of bone fracture	24	75.0
Rib cage	15	46.9
Spine	12	37.5
Neck	9	28.1
Head	5	15.6
Lower extremity	1	3.1
Findings		
Abrasion	22	68.8
Ecchymosis	26	81.3
Contusion	24	75.0
Laceration	16	50.0
Penetration	11	34.4

There was an eyewitness to the attack in 22 (68.8%) cases, and from the forensic documentation, it was determined that 8 (25%) cases received medical intervention.

When the types of animals causing the traumatic death were examined, the most frequent was cattle in 15 cases followed by horses in seven cases, bears in four cases, wolves in two cases, and wild boars in two cases.

According to the autopsy results, the cause of death was most often intrathoracic bleeding and intrathoracic organ damage, the regions of the body injured were seen to be most often the chest and back, and the most common form of injury was blunt/crush trauma. Of the total 32 cases, 24 had at least one bone fracture somewhere in the body. The most frequently observed external examination finding was ecchymosis, and the least frequently seen was penetration-laceration (Table 1 and 2). Hemopericardium due to blunt trauma on the chest caused by a donkey kicking with its hind leg is shown in Figure 1, and a displaced cervical vertebra fracture that develops as a result of the bovine crushing the case with body weight is shown in Figure 2.

As the cases included in the study came from 11 different provinces, the animals were classified according to their nature and it was determined that 24 were domestic or farm animals and eight were wild animals. A statistically significantly

Figure 1. Hemopericardium due to aortic root laceration as a result of blunt trauma.

Figure 2. Displaced cervical vertebra fracture with bleeding around. *Fisher's exact test, **statistically significant.

Table 3. Characteristics of the deaths according to the nature of the animals

	Nature of the Animal				p*
	Domestic		Wild		
	n	%	n	%	
Sex					0.148
Male	21	87.5	5	62.5	
Female	3	12.5	3	37.5	
Presence of eyewitness	18	75.0	4	50.0	0.218
Injured region					
Head	10	41.7	5	62.5	0.423
Neck	8	33.3	2	25.0	1.000
Chest-back	15	62.5	5	62.5	1.000
Abdomen-lower back	6	25.0	3	37.5	0.654
Upper extremity	3	12.5	1	12.5	1.000
Pelvis	1	4.2	1	12.5	0.444
Lower extremity	3	12.5	1	12.5	1.000
Perineum	1	4.2	1	0.0	1.000
Form of injury					
Blunt trauma- crush	16	66.7	5	62.5	1.000
Penetration by horn, claw	4	16.7	5	62.5	0.023**
Trampled	5	20.8	0	0.0	0.296
Bite	1	4.2	2	25.0	0.147
Rolling fall after attack	1	4.2	1	12.5	0.444
Cause of death					
Intrathoracic bleeding	12	50.0	2	25.0	0.412
Intrathoracic organ damage	11	45.8	2	25.0	0.420
Intra-abdominal bleeding	6	25.0	0	0.0	0.296
Intra-abdominal organ damage	6	25.0	0	0.0	0.296
Major vessel damage	3	12.5	1	12.5	1.000
Intracranial bleeding	5	20.8	4	50.0	0.176
Spinal cord damage	6	25.0	2	25.0	1.000
Widespread soft tissue bleeding	1	4.2	1	12.5	0.444
Rabies	0	0.0	2	25.0	0.056
Findings					
Abrasion	17	70.8	5	62.5	0.681
Ecchymosis	22	91.7	4	50.0	0.023**
Contusion	22	91.7	2	25.0	0.001
Laceration	10	41.7	6	75.0	0.220
Penetration	7	29.2	4	50.0	0.397

*Fisher exact test, **Statistically significant.

higher rate of contusions and ecchymosis was determined in cases of attack by domestic animals.

Ecchymosis, lacerations, and intracranial bleeding and laceration with skull fractures as a result of attacks by cattle are shown in Figures 3 and 4. Ecchymosis, lacerations, and penetrations as the result of an attack by a bear are shown in Figure 5a-c. The canine teeth of a wild boar are shown in Figure 6. Lacerations and penetrations as the result of an attack by a wild boar are shown in Figure 7a and b.

Figure 3. Wide and deep lacerations with an oblique course and ecchymosis caused by cattle horn immediately inferior to the inguinal region.

Figure 6. The upper and lower canine teeth can be seen in this wild boar killed by a hunter in the region.

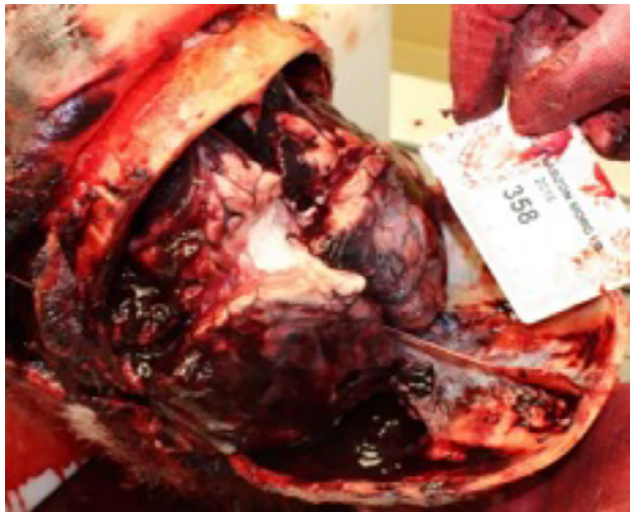

Figure 4. The hooves of the same animal used together with the body weight to create widespread fractures of the skull, causing widespread brain hemorrhage and brain lacerations.

DISCUSSION

Various commercial, professional, or sporting activities of humans with wild or domestic animal breeds living in different geographic regions can cause unexpected interactions between these two different species of mammals. The type of animal and the place and form of contact can affect the nature of the injuries sustained by the human. In addition to livestock husbandry, accidental encounters and contact with wild animals living in their natural environment during activities other than production such as hunting, swimming, and hiking may result in human deaths.

The current study cases comprised 26 (81.3%) males with a mean age of 61 years. This high predominance of male gender and older age was seen to be consistent with literature. In a study by Dogan et al.,[3] the rate of male cases was 80% and the mean age of all the cases was 60.3 years. In the current study, the only case aged <10 years was that of a child where the death was determined to be accidental as the result of a kick from a horse that was kept by the family. Public education is needed to raise awareness that animals are not playthings for children and children should be kept away from unexpected dangers as far as possible.

The male predominance can be attributed to the gender roles in society. Males work as shepherds for animals in open areas or as village guards, and participate more in hunting and outdoor sports so there is a greater risk of contact with domestic or wild animals, causing the higher rate of male deaths of this type.

The location of the attack that resulted in death was in open areas such as pasture or forest in 21 cases and in a barn or

Figure 5. (a-c) Widespread ecchymosis, lacerations, and many penetration injuries seen on the chest, abdomen, and back following a bear attack.

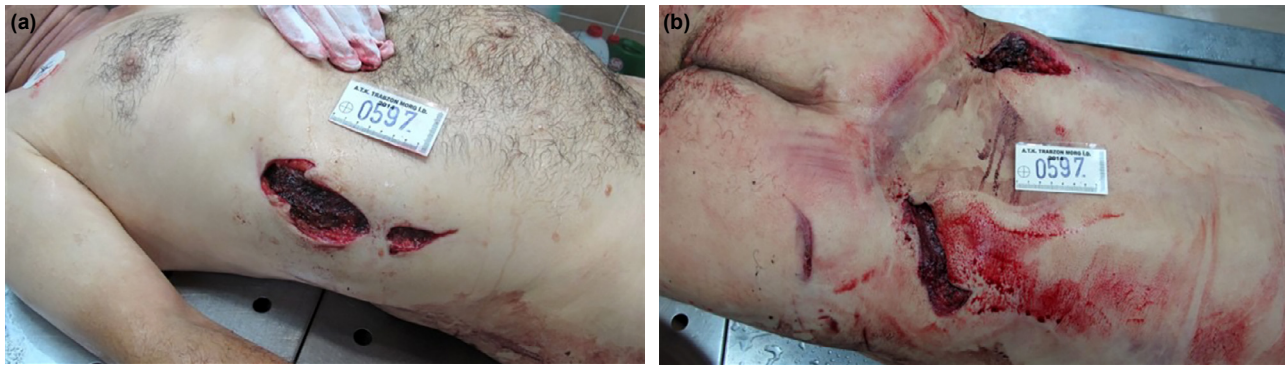

Figure 7. (a, b) Penetrating injuries causing internal organ laceration and internal bleeding in the right thoracoabdominal and bilateral thoracolumbar regions as a result of penetration of the lower canine teeth of a male wild boar.

other place around the home in 10 cases. Contact with wild animals was seen to be mainly in pasture and forested areas, and the deaths occurring in these areas were thought to be the result of people entering the habitat of the wild animal for hunting or sporting purposes. In one case, there had been contact with a wolf in the garden immediately in front of the house. It was later learned that the wolf had rabies, and the cause of death of this male case was rabies infection from a bite on the cheek from the wolf which was probably searching for food as it could not hunt because of the disease.

According to the Turkish Statistics Institute, 17,688 cattle were registered in Turkey in 2019.[19] In this study, the vast majority of deaths resulting from animal attack were determined to be from cattle (n=15, 46.9%). Cattle farming is widespread in Turkey, and these deaths may occur as farmers are not aware of or do not give importance to the aggressive behavior of the animals, especially during breeding seasons. A significantly high association was determined between deaths occurring as a result of attacks by domestic/farm animals and the findings of contusion and ecchymosis. These cases were mostly determined with ecchymosis, lacerations, bone fracture, internal organ laceration, and internal bleeding (Figs. 3 and 4). The characteristics of these traumas were found to be consistent with findings in literature.[1,3,20] Significant ecchymosis and lacerations were determined in the perineal region in one case. In this localization of trauma, care must be taken in the differential diagnosis, as it may be important to discount other causes such as sexual assault.

The second most common cause of death was seen to be from horses at 21.9% (n=7). A kick from a horse, especially from the hind legs, transfers the energy produced by the strong leg muscles from the hard hoof to the target. In the findings of this study, it was understood that bone fractures of the skull and chest region together with internal organ contusions, lacerations, and internal bleeding had been caused by the transfer of this energy to the target. The localization of trauma caused by horses in the head and chest was consistent with previous findings in literature. A surviving case has been reported where a kick to the head from a horse caused bilateral vertebral artery occlusion and carotid artery dissection.[1,5] In one case of the current study determined with only superficial trauma, it was understood that the death by drowning in a pond was the result of a fall following trauma created by the horse.

Of the deaths resulting from wild animal attacks, four cases were related to an attack by a bear, two by wolves and two by wild boars. The grizzly bear (Ursus arctos) is a large mammal widely seen throughout the northern hemisphere and has a native habitat in Turkey.[21] Encounters by humans both when hunting or by chance in mountainous or forested areas are especially dangerous with male bears during the mating season or with females with young cubs. Bears coming to take honey from the hives found near homes are nervous rather than aggressive and are, therefore, not likely to cause injury or death. All of the four cases of death from a bear attack in the current study had widespread lacerations, contusions and claw penetration on the chest, abdomen, and more intensely on the back, and in addition to the invasive lesions caused by the teeth and claws used as weapons, death was determined to have been caused by the bear crushing the victim with its body weight (Fig. 5). These traumatic findings were seen to be consistent with grizzly bear attacks in the literature. However, in contrast to the findings in literature, no signs of bear bites were determined in the four cases of this study, and no tissue loss or amputation that destroyed the integrity of the body.[22,23]

The wild boar (Sus scrofa) is a cloven-hoofed animal from the porcine family which is considered to be the wild ancestor of the domestic pig.[24] These animals are common in the wild in the region where this study was conducted. Wild boar has four canine teeth which can grow as long as 20 cm, which they primarily use to dig in the soil, but will use as a weapon if they perceive a threat (Fig. 6). There are reports in literature of wild boar attacks on people while hunting or engaged in farming activities, and in the two cases in the current study, the history was of injury while hunting. Consistent with the previous findings in literature, in both cases, internal organ injury and bleeding were determined caused by penetration of these canine teeth of the boar (Fig. 7a and b).

The results of this study showed that the most common cause of death in traumatic animal attacks was intrathoracic bleeding and intrathoracic organ damage, the majority of cases had at least one bone fracture, and consistent with literature, the most common form of injury was blunt crush trauma. Medical intervention was made in one in four of the cases, which increases the hope of being able to reduce the mortality rate. In addition, the presence of a witness in two-thirds of cases can be considered to shorten the time for transport and intervention, and is, therefore, important in the emergency traumatology approach.[25,26]

Conclusion

Early diagnosis and treatment with the chance of treatment by a mobile health-care team at the site of the incident or treatment in a health-care center are the basic determinant factors following trauma. In the emergency traumatology practice, there are extremely few animal attacks compared to the frequently encountered cases of traffic accidents, physical assaults, and falls from height. However, in the emergency traumatology interventions, which are of great importance, especially in rural areas, the differential diagnosis of animal attacks from other blunt trauma injuries is important in respect of the prevention of possible infections such as rabies, and the capture of the animal. Moreover, in traumatic animal attacks, it is important that a detailed evaluation is made of penetrating-cutting instrument injuries such as laceration, bite marks, bone fracture, and penetration, which are not pathognomonic for these assaults, for a detailed differential diagnosis with sexual assault, child abuse, and possible murder.

Ethics Committee Approval: This study was approved by the Ministry of Justice Forensic Medicine Institute Presidency Ethics Committee (Date: 31.01.2017, Decision No: 21589509/63).

Peer-review: Internally peer-reviewed.

Authorship Contributions: Concept: H.Ç.K., G.S.K., E.Ö.; Design: H.Ç.K., G.S.K., E.Ö.; Supervision: H.Ç.K., G.S.K., E.Ö.; Resource: H.Ç.K., H.B., G.S.K., N.E.B.; Data: H.Ç.K., H.B., G.S.K., N.E.B.; Analysis: H.Ç.K., H.B., G.S.K., N.E.B.; Literature search: H.Ç.K., G.S.K., E.Ö.; Writing: H.Ç.K., G.S.K., E.Ö.; Critical revision: H.Ç.K., E.Ö., Y.B.

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ORİJİNAL ÇALIŞMA - *ÖZ*

Hayvan saldırısına bağlı travmatik ölümlerin değerlendirilmesi: 10 yıllık otopsi çalışması

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AMAÇ: Hayvan ilişkili ölümler dünya genelinde olduğu gibi Türkiye'de de bir halk sağlığı problemi olmaya devam etmektedir. İnsanların invazyonu nedeni ile doğal yaşam alanlarının daralması ve bu alanlarda yapılan avcılık, odunculuk, eğlence ve sportif amaçlı etkinliklerden dolayı insanlarla vahşi hayvanların karşılaşma olasılığını artırmaktadır.

GEREÇ VE YÖNTEM: Çalışmamızda Ocak 2007–Aralık 2016 tarihleri arasındaki 10 yıllık sürede Adli Tıp Kurumu Trabzon Grup Başkanlığı'nda otopsisi yapılan toplam 8944 olguya ait adli dosya fiziksel olarak, geriye dönük yöntemle taranmıştır. Bu dosyalar içerisinden travmatik hayvan saldırısı nedeniyle öldüğü tespit edilen olguların sosyo demografik özellikleri, yaralanmaya neden olan hayvanların cinsleri ve nitelikleri, olay yeri bilgileri, tanık ifadeleri, sağlık kuruluşuna ait bilgiler, dış muayene ve otopsi bulguları ve ölüm nedenleri çalışma kapsamında incelenmiştir.

BULGULAR: Travma nedeniyle ölüme neden olan hayvan türlerine bakıldığında; 15 olgu ile en sık karşılaşılanların sığır cinsi büyükbaş hayvanlar olduğu, ikinci sıklıkta karşılaşılan hayvan türünün yedi olgu ile at olduğu, dört olguda ayı, iki olguda kurt, iki olguda da yaban domuzu gibi vahşi hayvan türleri olduğu görülmüştür.

TARTIŞMA: Otopsi sonuçlarına göre ölüm nedenlerine bakıldığında; en sık karşılaşılan nedenin göğüs içi kanama ve göğüs içi organ yaralanması olduğu, en sık yaralanan bölgenin göğüs ve sırt, en sık yaralama biçiminin ise künt-ezici travma şeklinde olduğu görülmüştür.

Anahtar sözcükler: Hayvan saldırısı; otopsi; travmatik ölüm.

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