The Challenges in Autopsy Cases Exposed to Animal Attack

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Abstract

Discrimination between antemortem and postmortem lesions inflicted by animals from other traumas, and contribution of these injuries to the cause of death which is often encountered in forensic autopsies may cause some difficulties. Detailed identification, and, evaluation of bite marks which has the depth and shape of the teeth and jaw of the animal interfering to the cadaver, tissue losses, paw and tooth marks nd vital signs must be performed during autopsy. Current autopsy reports filed in the Morgue Department of Council of Forensic Medicine between the years of 1996 and 2001 had been retrospectively screened and various cases inflicted by animals during antemortem, perimortem and postmortem periods had been included in the study in order to determine emerging problems in autopsy cases with signs of animal attack and develop recommendations for points to be considered in these cases. Location of animal attack, severity of injury, typical wound characteristics, differential diagnosis among other lesions, the cause of death and effects on identification of the victim and consequences in terms of forensic medicine were evaluated based on autopsy reports of 130 cases. Postmortem (n=129 cases) and antemortem (n=1) signs of animal attack were detected. Lesions were commonly caused by marine animals, and observed on the head region. The identity of the victims, and cause of death couldn't be determined in 22, and 48 % of the cases, respectively. When we consider the problems encountered during phases of determination of the cause and type of death and identification of the signs of postmortem animal scavening, the importance of forensic medicine approach in crime scene investigation on antemortem and/or postmortem animal attacks, identifying the profile of the offending animal and the challenging autopsy procedure becomes much clearer.

Key Words: Autopsy, animal intervention, postmortem, bite

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Introduction

While animal interventions can happen before, and/or after death of the victim, mostly postmortem lesions are encountered during forensic medicine examinations. Various animal species peculiar to the geographic region of the event can attack to the corpse. Indoor domestic animals such as dogs, mice and cats, and those living outdoor as dogs, mice, foxes, coyotes, pigs, scavenging birds, and marine animals as fish and crustaceans can attack human remains [1]. Bite marks created by teeth and jaw of the animal, tissue losts, claw and singular tooth marks can be determined at autopsy. These interventions can happen before, and/or after death, or at the moment of death, which can create problems in differential diagnosis [1-4].

Apart from determining the time of the lesions incurred by animal interventions, it is also necessary to separate these lesions from other traumas. Indeed discrimination between penetrating stab wounds from animal bites and horn injuries is very difficult in complex cases [5]. Identification of the offending animal is another challenging issue. During crime scene investigation the place where corpse was found, environmental conditions, climate, animal species living in this geographic region, animal's feeding and behavior patterns are important issues to be determined. Wounds detected on the corpse can be inflicted by a carnivorous animal during hunting or attacks for feeding on dead bodies exposed to a murder, suicide or an accident. It should be taken into consideration that, in this situation the only scavengers are not carnivorous animals, but also rodents, bugs, crustaceans, fish and fowls are prone to scavenge on corpses [2,6,7].

Determination of the identity of the corpse poses difficulties. Any trace of the corpse can not be detected because of scavenger feeding. Scavenger feeding can cause problems in forensic medicine evaluation related to determining the cause of death and identification of the attacker [1, 6, 9]. When death occurs outdoors, the parts of corpse can be scattered away by predators such as dogs, coyotes, foxes, and wolves. Decomposition of the corpse can develop rapidly making it difficult to determine the characteristic features of probable traumatic wound, the cause of death and the identity of the victim [2,10,11].

If death occurs indoors, soft tissue lesions can be seen on naked parts of the body especially on face, head, and neck. Pets, within a few days, in some cases within just a couple of hours, can create wounds. This situation makes it difficult to determine the time of death, even the

incident can be mistaken as a murder. Sometimes, pets can bite their owners who died recently or on the verge of death, with the intention of waking them up and can cause wounds at the moment of death. Wounds can be detected on naked parts of the body or where clothing is thin, and the animal can easily claw. These types of wounds can be interpreted mistakenly as wounds caused by an attack (for example, for the purpose of rape) [1,7].

Because marine animals can enter body holes from wounds on the corpse and natural open cavities such as mouth, nose and anus causing artifacts misleading the forensic medicine specialist [7,12]. The phases of decomposition (disarticulation) caused by animal intervention are defined by Haglund [13].

Disarticualtion/scavengering scale:

- Phase 0: 4 hours - 14 days after death: Limited to early loss of soft tissues without any signs of disarticulation;

- Phase 1: 22 days-2,5 months after death: Fragmentation of ventral thorax characterized by loss of sternum, partial/complete destruction of sternal rib extensions, scapula, partial/ whole clavicula, evisceration, and loss of one or both upper limbs;

- Phase 2: 2-4,5 months after death: In addition to the phase 1, destruction/loss of lower limbs

- Phase 3: All skeletal parts excluding the spinal articulations are disintegrated, severely damaged or destroyed. Bones are scattered within a distance of 3 and 91 m. Time of staying outside changes from 2 to 11 months.

- Phase 4: Preservation of cranium and some bones and bone fragments, together with total disarticulation and scattering. The time of staying outside changes from 6 to 52 months.

However, there can be atypical decomposed human remains which do not fit into these categories. Presence of atypical, deformed bones differentiate these cases categorized in previously discussed phases.

Due to the difficulties experienced in determining the time of the culprit lesion, and contribution of the identity of the victim, and animal interference to the cause of death, our aim

was to determine problems arising during autopsy, and develop suggestions related to the important points to be considered during postmortem examinations of these cases.

Material and Methods

The forensic records of 11.015 deaths referred to Council of Forensic Medicine for autopsy in 1996–2001 were reviewed and cases with lesions created by animals before, after, and at the time of dying were included in the study. From a total of 11.015 autopsy reports, only in 130 cases, lesions caused by animal intervention were detected. The reports of 130 autopsy cases were evaluated in terms of locations exposed to animal attacks, typical wound patterns, methods of differential diagnosis among other lesions, and categorized according to event sites, actual weather conditions, and season of the year, and their effects on identification of cause of death, the victim, and the scavenging animal, and forensic medicine assessment of the death case.

Results

From a total of 11.015 autopsy cases, only in 130 corpses (males, n=114, 88 %; females, n=16, 12 %) evidence of animal intervention was detected. Mean age of the identified cases at the time of the event was 36.13 ±18.55 years (range: 0-85 yrs). Age of 13 cases could not be determined. Five cases were dead bodies of newborns who demonstrated signs of intervention by a mouse or mice (n=1; phase 0), a mouse or mice and a dog or dogs (n=1; phase 2), dog or dogs (n=3; phases 0,1, and 2). Identity of %22 of the cases couldn't be determined.

In 129 cases, signs of postmortem animal intervention and in one case antemortem animal attacks were detected. The cause of death of the victim who was attacked before death, was reported as cardiovascular disease.

Dead bodies of the victims were found underwater (14%), on the open territory (24 %), indoors (19%), in the vicinity of river and/or lake, in a car, in trashes and unknown places. The culprit scavenging animals were marine animals (49%), mice (35 %), dogs and mice(13 %) and dogs (4 %). Dogs inflicted lesions on corpses mostly (88 %) in open areas, mice indoors (53 %), and marine animals in the sea or on the shore (95 %).

Cases of disarticulation were in phase 0 (n=112; 86 %), phase 1 (n=12; 9 %), phase 2 (n=6; 5 %). In for of the six cases in which phase 2. decomposition was detected the responsible animal was dog or dogs, and in four of them, it was sea creatures. The comparison between decomposition phases and animal species which intervene can be seen in Table 1.

Table 1. Comparing animals creating lesions and stages of disarticulation.

	Stage of disarticulation			
Scavenging animals	0	1	2	TOTAL
Mice	43	2	0	45
Dogs	6	9	2	17
Marine animals	60	1	2	63
Mice and dogs	3	0	2	5
Total	112	12	6	130

Peak time of occurrence of the lesions inflicted by scavenging animals differs widely (mice, November-April; dogs, August-November, and marine animals, May-September) (Table 2).

Table 2. Distribution of cases according to species of interfering animals and time of the incident.

	Distribution of death cases (n) based on the time of the incident												
SCAVENGING ANIMALS	January	February	March	April	May	June	July	August	September	October	November	December	TOTAL
Mice	6	7	6	7	0	3	3	0	1	2	7	3	45
Dogs	1	1	1	1	3	0	0	3	2	2	2	1	17
Marine animals	3	6	2	3	10	7	11	12	5	1	1	2	63
Mice and dogs	0	0	0	0	1	0	0	2		1	0	1	5
TOTAL	10	14	9	11	14	10	14	17	8	6	10	7	130

Death events mostly due to drowning in water (n=33; 25 %), followed by wounds caused with a fire arm, mechanical asphyxia by hanging, stab wounds and cardiovascular diseases. In 62

cases (%48) the cause of death couldn't be determined. The comparison between causes of death and intervening animal species can be seen in Table 3.

Table 3. Causes of death categorized according to species of scavenging animals

Causes of Death	**Species of Scavenging Animals**				
	Mice	Dogs	Marine animals	Mice and dogs	Total
Drowning	2	0	31	0	33
Gun shot wounds	3	2	1	0	6
Blunt head trauma	3	0	0	0	3
Lung infection	3	0	0	0	3
Alcohol intoxication	2	0	0	0	2
Hanging	3	1	0	0	4
Manual strangulation	1	0	0	0	1
Cardiovascular failure	4	0	0	0	4
General body trauma	1	0	0	0	1
Menengitis	1	0	0	0	1
Cancer	2	0	0	0	2
Stab wounds+blunt head trauma	0	1	0	0	1
Stab wounds	0	2	0	2	4
Cerebral hemorhage	1	0	0	0	1
Unknown	18	11	30	3	62
Hanging	1	0	0	0	1

Table 4. Bodily locations and anatomical structures affected by fatal wounds determined to be caused by mice during postmortem period.

Location of the wounds	Skin, subcutaneous Tissue	Deep soft Tissue	Bone defects	Severe Skeletonization	Total	N (%)
Orbita	3	21			24	24 (3.33)
Nose	5	18			23	23 (51.11)
Mouth	5	16	1		22	22 (48.88)
Ear	6	17			23	23 (51.11)
Lower jaw	3	15			18	18 (40)
Scalp	3	10	1	1	15	15 (33.33)
Neck	1	10			11	11 (24.44)
Chest	1	2	1		4	4 (8.88)
Abdomen	2	1	1		4	4 (8.88)
Pelvic		1			1	1 (2.22)
Back		2			2	2 (4.44)
Shoulder			1		1	1 (2.22)
Arm		2	2		4	4 (8.88)
Forearm-wrist	2	3	1	2	8	8 (17.77)
Hand	5	7	1	4	17	17 (37.77)
Thighs-knee		1			1	1 (2.22)
Legs	1	2	3		6	6 (13.33)
Feet	1	2	2		5	5 (11.11)
Spine			1		1	1 (2.22)
Total	38 (20)	130 (68.4)	15 (7.9)	7 (3.7)	190 (100)	

Table 5. Bodily locations and anatomical structures affected by fatal wounds determined to be caused by dogs during postmortem period.

Location of the wounds	Skin, subcutaneous Tissue	Deep soft Tissue	Bone defects	Severe Skeletonization	Total	N (%)
Orbita		8		1	9	9 (52.94)
Nose		8		1	9	9 (52.94)
Mouth		8		1	9	9 (52.94)
Ears		8	1	1	10	10 (10.82)
Lower jaw		7		2	9	9 (52.94)
Scalp		7	1	2	10	10 (50.82)
Neck		3	2	2	7	7 (41.17)
Chest		4	8		12	12 (70.6)
Abdomen		4	2		6	6 (35.3)
Pelvis		1			1	1 (5.88)
Back			1	1	2	1 (11.76)
Shoulders		2		1	3	3 (17.64)
Arm		3	1	4	8	8 (47.05)
Forearm-wrist		1	1	3	5	5 (29.41)
Hand		2	2	3	7	7 (41.17)
Thigh-knee	1	2			3	3 (17.64)
Legs	1	2			3	3 (17.64)
Feet				1	1	1 (5.88)
Spine			1	1	2	2 (11.76)
Total n (%)	2 (1.7)	70 (60.3)	20 (17.24)	24 (20.68)	116	

Table 6. Bodily locations and anatomical structures affected by fatal wounds determined to be caused by marine animals during postmortem period.

Location of the wounds	Skin, subcutaneous Tissue	Deep soft Tissue	Bone defects	Severe Skeletonization	Total	N (%)
Orbita	24	14			38	38 (60.31)
Nose	8	12			20	20 (3.17)
Mouth	12	9			21	21 (33.33)
Ears	9	12			21	21 (33.33)
Lower jaw	4	8			12	12 (19.04)
Scalp	8	11			19	19 (30.15)
Neck	4	1			5	5 (7.93)
Chest	4	5			9	9 (14.28)
Abdomen		2	1		3	3 (4.76)
Pelvis	1	3			4	4 (6.34)
Back	1	2			3	3 (1.58)
Shoulders	2				2	2 (3.17)
Arm	6	5			11	11 (17.46)
Forearm-wrist	10	5	1	2	18	18 (28.57)
Hand	9	6	1	2	18	18 (28.57)
Thigh-knee	4	4	1		9	9 (14.28)
Legs	4	2	1		7	7 (11.11)
Feet	2	3	1	1	7	7 (11.11)
Spine				1	1	1 (1.58)
Total N (%)	112	104	6	6	228	
	(49.13)	(45.6)	(2.63)	(2.63)	(100)	

Table 7. Places in which dead bodies were found, and species of the interfering animals.

Scavenging animals	Land	Sea	River	Lake	Indoor	Unknown	Dumping ground	In motor vehicle	Total
Mice	15	1	0	1	24	3	0	1	45
Dogs	12	0	3	0	0	2	0	0	17
Marine animals	0	60	1	2	0	0	0	0	63
Mice and dogs	4	0	0	0	0	0	1	0	5
Total	31	61	4	3	24	5	1	1	130

Discussion

The lesions hardens the job of forensic medicine specialists encounters difficulties while determining the time (before, after or at the moment of dying) and cause of death and the lesions inflicted by animals. These lesions should be differentiated from other traumatic wounds, stab wounds. Although mostly postmortem animal bites are observed in forensic autopsies, they can occur at the moment of dying, even both before, and after death.

In deaths accompanied with multiple bite marks, study should start by answering to the questions whether the scavenging animals are of the same species or not. Wounds specific to certain animal species carry discriminative qualities for a forensic anatomist.

The animal species which are responsible for the destruction of the corpse can vary highly according to the geographical conditions. This wide spectrum includes regional predators such as bears, coyotes, wolves, foxes, wild dogs, hyenas, and also pets as dogs, sea predators as sharks, and other animal species like birds, bugs, and crusteceans [6,10]. In this study a significant correlation was determined between the event site found the animal species which intervened. Human cadaveric lesions caused by dogs were found in corpses lying outdoors, and by mice indoors (Table 7).

Distribution of lesions based on the time of the event demonstrated that mice mostly incur cadaveric lesions between November–April during the time interval when people prefer to stay indoors. However dogs attacks human beings in summer and fall when people prefer to stay outdoors. Marine animals cause traumatic lesions on human beings during swimming season (Table 2).

The impact of animal intervention on the establishment of the time of death should be calculated by taking all adverse conditions in to consideration including rate of the decomposition process of the corpse, and presence of bugs, and larvae around the dead body. As it is known, animal intervention often can be seen in the corpses left outside. The alterations in the integrity of the dead body because of this intervention complicate determination of the time of death. Mostly, due to animal intervention, the corpse can be moved away from the scene of the event, components of the skeleton disintegrate, actual height of the victim decreases, and human remains scatter around. These events should be taken into considereation

while determining the time of death [13,14]. According to the phases which are based on disarticulation scale [13] which evaluates severity of the lesions caused by animals, dogs mostly create lesions leading to loss of tissue including deep soft tissue, followed by severe skeletonising wounds and severe tissue loss on bone tissue characterised with defect (Table 1). In these cases, determining the time of death is an important problem. Without a detailed crime scene investigation which takes disarticulation phases, regional animal species into consideration, it can be nearly impossible to have an opinion about the time of death.

In death cases which occurred long time ago, the time of death generally calculated by taking decompositon level of the corpse, presence of bugs in the vicinity, rotting of related plants and wearing out of clothing into consideration. In order to determine the phases of cadaveric decay, controlled studies should be done by elimating the natural variables like animal feeding [14]. In the study of Willey and his colleagues [14], the observations on the wolves which feed on corpses of deer, demonstrated that physical decay, bug growth and other factors also altered during the course of feeding. For an accurate determination of time of death, models which will be structured on controlled experiments should be developed and natural variations should be taken into consideration and implemented [14,15].

Animal interventions can also cause problems during the identification process of the corpse. Carnivorous animals and rodents firstly devour soft tissues of face and neck making identification of the corpse almost impossible. In such a case the animal should be found within a very short time and examination of it's stomach content, blood spots and tissue debris on it's fur, carries great importance [16-22]. Distribution of animal bites, locations and severity of tissue losses was evaluated and lesions caused by mice, dog and marine animals are found on the head; particularly involving orbita, nose, mouth, ear, lower jaw and the scalp (Table 4, 5, 6). In accordance with the literature, %22 of the cases were unidentifiable which reveals that there are serious problems related to identification of the cases attacked by animals. Although DNA typing is possible for identification, it is very much important to know a certain characteristics of the victim and have an identification photograph in order to inquire the identity of the person.

If the corpse is found during warm seasons, larvas or some various worms which can be encountered inside decaying corpses can cause difficulties during identification process

because of large tissue losses occurring in a short period of time. Skin loss can prevent detection of probable surgical scars which could be used for identifying and studying tattoos [21]. While these defects can imitate stab wounds, they can also hide some already existing wounds. Larvas and worms can infiltrate in to the organs of the dead person, and cause important changes in tissues. Also, destruction of internal organs can hide underlying organic diseases which were partially or totally responsible for the death event [10]. In the study of Byard and his colleagues, even the corpse found in a ship which came across the ocean had been decayed, but the authors determined the region where the corpse had been drifted from by analyzing the species of worms on it. Although entomology helps to clarify the identity of the corpses which exposed to animal attacks, an entomological study had not been conducted in any case investigated in our study. Local studies done in the area of entomology will cover this insufficiency.

Bite mark analyisis should be an important headline in the forensic autopsy. Accurate dental pressure and a prosthesis of animal teeth can be required in order to be sure whether it is an animal attack or not. Forensic dentists practise this applications on animals [1,7,23,24]. Determining the species of the animal which intervened the corpse is important to clarify the incident. American Forensic Odontology Board, published a guide of human teeth analysis which can be applied to all animal species including dogs [25]. According to this guide, the steps on analysing the bite marks should include steps of description of the bite mark, collecting evidence from the victim and the suspect animal. It can be seen that in any case in the course of study, there is no detailed description of the bite marks and any odontological study targeting determination of the species of the animal has not been conducted so far.

Animal intervention can hide the cause and mechanism of death. Postmortem feeding of animals can make it difficult to identify the corpse in a detailed way and studying probable wounds above all determining the cause of death [10,14,16-22,26]. Because animals start the intervention by eating from the mouth and areas of bloody wounds, resultant destruction of the critical areas in determining the cause and mechanism of death or eating the parenchymal structure of visceral organ can create problems in identifiying the natural disease that caused the death. So traumatic wounds especially firearm wounds, blunt trauma, stab wounds may disappear, after scavengering by a predator, and postmortem wounds may be mistakenly regarded as antemortem wounds. For this reason lesions created by predators must be examined

in detail keeping the possibility of antemortem trauma in mind [6,7,9,14]. Since wounds have not been described in detail in our cases, comments could only be made on general wound definitions. Evaluation of wound's vividness can be very conducive for diagnosis. Forensic specialists must create models for recognition and depiction of specific lesions such as canine teeth marks, scissor cuts, and paw scars [27]. The reason why cause of death has not been determined in 48 % of the cases has been thought to be as a consequence of animal interventions which masked the cause, and type of death in some of these cases. Also all causes of death except drowning, which included firearms, penetrating-perforating instruments, and strangulation were encountered at higher rates which gave additional support to this argument.

Crime scene investigation, identification of animal species and type of animal interference, and autopsy findings are highly important in forensic medicine investigations for fatal animal attacks. Besides detailed investigation at crime scene and on corpse, examination of the culprit animal must be made, which may need more effort than postmortem examination of the corpse. Any kind of evidence belonging to the victim on animal (such as hair, blood, cloth fiber), urine sample of animal and contents of its mouth and stomach must be examined, if neccessary, nuclear and mitochondrial DNA examination of saliva and blood spots belonging to animal on corpse and clothes must be made, cloth fibers must be looked for on skin, fur or hide of the scavenging animal and odontologic analysis of bite traces on corpse must be made [28].

As a result, in this study importance of crime scene investigation, identification of the species of the offending animal, type of animal intervention, interfering, finding animal and autopsy on corpse in forensic scientific approach to deadly animal attacks and postmortem animal intervention has been emphasized again. Creating standard models for identification of animal's bite trace and application of these models in forensic odontology and forensic science would standardize identification of death cases, and precise specification of time, and cause of death and reason during necropsic examinations. Data in this study can be used as a model in further studies for the definition of the time of the animal attacks with reference to time of death.

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