CASE SERIES

Patterns of Game Animal Attacks on Hunters in Croatia Over a 13-Year Period

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Hunter-game animal conflicts are occasionally reported from various parts of the world. This case series comprises all 7 game animal attacks on hunters reported to the Croatian Hunting Association over a period of 13 years (1999–2011), covering the entire Croatian territorial area. Seasonally, attacks occurred most frequently in the winter time, when the hunting season is at its peak. The most common attacking animal, representing 5 of 7 cases (71.4%), was the wild boar, and the majority of the attacks happened in the morning. All of our victims were male, with an average age of 51 years (range 26 to 69 years). Six victims sustained a bite wound or wounds and 1 was rammed by the animal. Almost all of our patients (5 of 7, with one unknown) recovered completely and without significant complications.

Key words: wild animal, trauma, bites and stings, wild boar

Introduction

The interaction between humans in general and wild animals has increased in recent times all over the world, mainly because of the geographic overlap of natural and traditional animal habitats with the increasing and spreading human population. Attacks on humans by game animals causing injuries are not uncommon in rural and forested areas, and there are also numerous reports of human fatalities in such encounters.^{1–11} Wild animal injuries inflicted on humans are mostly to soft tissues and organs. The injury mechanisms may include biting, tearing, cutting, penetrating, and crushing; these injuries may be further combined with falls caused by tackling or simply very intense animal forces causing blunt trauma.^{12,13}

Croatia is a part of the Balkan Peninsula and thus a part of the Mediterranean basin, one of the world's 25 biodiversity hotspots,¹⁴ inhabited by several potentially dangerous game animals. Hunting in Croatia has throughout history been traditionally very important and remains ubiquitous. Hunters are at the greatest risk of being attacked by game animals as they usually have more contact with them than the rest of the population.¹⁵ The aim of this study was to investigate the patterns

of game animal attacks and injuries on hunters over a 13-year period.

Methods

The study was carried out over the entire Croatian territory, which is located between 46°33' and 42°23' northern latitude and 13°30' and 19°27' eastern longitude, with a total surface area of 56,542 km² and a population size of 4,290,612.¹⁶ We analyzed a total of 7 cases of game animal attacks on hunters over the 13-year period (1999–2011) that were reported to the Croatian Hunting Association (CHA). The data were collected from hunting records, a useful tool for evaluating trends in game animal impact,¹⁷ with great precision and covering the whole country. We also reviewed medical records that were filed together with the insurance claims to the CHA. Verification of all animals attack in the study with regard to the game species and the injury status was carried out by government officials from the CHA. For each case, we extracted the following information: 1) species of the game animal, 2) date and time of the attack, 3) the geographic location of the attack, 4) the type of injury, 5) treatment, and (6) medical outcome.

Results

During the study period, hunting conditions have not changed but the number of hunters has slightly increased (Figure). The attacking animals were a wild boar (*Sus*

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Figure. Number of hunters in Croatia over the 13-year period (1999–2011).

scrofa) in 5 cases (71.4%), a brown bear (*Ursus arctos arctos*) in 1 case (14.3%), and a roe deer (*Capreolus capreolus*) in 1 case (14.3%). Seasonally, attacks occurred most often in the winter months (71.4% in November), when hunting season is at its peak. All victims were male; they ranged in age at the time of attack from 26 to 69 years, with an average of 51 years (Table). Six of the 7 men were hunters who were attacked during the hunt, and 1 was a gamekeeper attacked during his tour of the hunting ground.

Case Presentations

CASE 1

A 26-year-old hunter was rammed by a running roe deer buck on the front side of his right thigh during a drive hunt (“driving” or “drive hunt” is a type of organized group hunt where a group of hunters, often with hunting dogs, are herding or chasing animals in a particular direction, usually toward another group of hunters who then shoot the animals; it is a widespread type of hunting in this part of Europe, mainly used for hunting wild boars) on November 13, 2005, at approximately 11:30 AM. He received first medical treatment in a small village medical office immediately after the attack, and then was transferred to the local general hospital where he was diagnosed with a distortion of the right knee and a rupture of the anterior cruciate ligament. There was no further medical documentation for the follow-up of that patient and therefore the outcome is unknown.

CASE 2

A 40-year-old hunter was attacked by a wild boar during a drive hunt on November 3, 2007, at approximately 10:00 AM. He first received medical treatment by an emergency medical team on site, and then was transferred to the local general hospital. In the attack, he sustained a bite wound to the left thigh, which was explored, cleaned, drained, and sutured; he also had multiple superficial scratches to the right thigh that needed no surgical treatment. He was immediately administered a tetanus toxoid booster, rabies post-exposure prophylaxis and antibiotics—2400 IU penicillin intramuscularly for the first 2 days and then metronidazole, 500 mg three times a day, for the next 7 days. The patient refused admission and was treated through the outpatient care system. He had made a complete recovery without any complications as of January 18, 2008.

CASE 3

A 69-year-old hunter was attacked by a brown bear while stalking a roe deer on September 28, 2009, around 7:15 PM. He sustained a 1-cm deep bite wound to the left upper arm and multiple superficial scratches of the left hand and both legs. According to his words, he heard a noise from the bushes behind him so he turned around and saw a female bear with 2 cubs. She charged toward him; he managed to grab his rifle and lodge it in her mouth, but he then sustained a bite to the left upper arm. The victim screamed loudly, stopping the bear, who then

Table. Details of all game animal attacks

Case	Victim age	Date of attack	Time of attack	GPS coordinates of attack	Game species	Injury type and localization	Outcome
1	26	Nov 13, 2005	11:30 AM	N 46°09'21" E 16°43'46"	Roe deer	Ramming into the right leg with knee distortion and ACL rupture	Unknown
2	40	Nov 3, 2007	10:00 AM	N 45°48'36" E 17°17'34"	Wild boar	Bite wound left thigh, right thigh scratches	Complete recovery
3	69	Sept 28, 2009	7:15 PM	N 45°20'17" E 14°37'24"	Brown bear	Bite wound left upper arm, scratches of left hand and both legs	Complete recovery
4	63	Nov 1, 2009	10:00 AM	N 45°44'42" E 17°32'41"	Wild boar	Bite wound left thigh with muscle tearing	Complete recovery
5	51	Nov 14, 2010	9:30 AM	N 45°42'22" E 17°05'38"	Wild boar	Bite wound right thigh and left lower leg with muscle tearing	Residual nerve and muscle damage right thigh and left lower leg
6	62	Nov 15, 2010	8:30 AM	N 45°22'8" E 14°15'44"	Wild boar	Bite wound left lower leg with muscle tearing	Complete recovery
7	46	March 1, 2011	11:15 AM	N 45°17'19" E 17°53'25"	Wild boar	Large superficial bite wound with skin tearing left side of back	Complete recovery

followed her already retreating cubs. He did not seek immediate medical attention because in his words “the pain was bearable and the wound had no signs of infection.” He was finally examined by a local physician on October 12, and there were no signs of complications or inflammation, and he had a complete recovery.

CASE 4

A 63-year-old hunter was attacked by a wounded wild boar during a drive hunt on November 1, 2009, at 10:00 AM. He sustained a 15-cm deep bite wound to the left thigh with muscle avulsion to the bone. From the force of the impact, he fell and hit a rock formation, sustaining a contusion to the left side of the back. He received initial medical treatment by a local health center, and then was transferred to the local general hospital because of his multiple chronic illnesses (arterial hypertension, decompensated hypertonic heart disease, paroxysmal atrial fibrillation) and the need for operative debridement. The bite wound was explored, cleaned, drained and sutured; and the patient was administered a tetanus toxoid booster, rabies post-exposure prophylaxis and dual antibiotic therapy—ciprofloxacin, 400 mg twice daily, and clindamycin, 600 mg 3 times daily, for 7 days (he had reported prior penicillin allergy)—because primary closure of a high-risk wound was performed. He was hospitalized until the 28th of November owing to the development of a life-threatening pulmonary embolism that occurred on November 2 (the second day of hospitalization) that arose because of his chronic diseases and prolonged stationary position and resting because of the trauma. After intensive care and treatment, he was released in a good overall state and had completely recovered without any residual impairment in regard to the trauma itself.

CASE 5

A 51-year-old hunter was attacked by a wild boar during a drive hunt on November 14, 2010, at approximately 9:30 AM. He sustained 2 bite wounds, one to the right thigh and another to the left lower leg, both with local muscle-tearing injury. First medical treatment was given to him at the local general hospital. The wounds were explored, cleaned, and sutured. He was also administered a tetanus toxoid booster, rabies post-exposure prophylaxis and antibiotics—amoxicillin plus clavulanic acid, 1000 mg (875 mg amoxicillin + 125 mg clavulanic acid), twice daily for 7 days. Initial physical rehabilitation began in the hospital where he remained until November 19, 2010. On a regular follow-up examination on the 5th of January, 2011, he complained of numbness in the left foot, and a physician observed a muscle deformity of the

right thigh; the patient was examined by a rehabilitation specialist on the 14th of January, and was diagnosed with a muscle hernia of the right thigh, a contracture of the left ankle, and a suspicion of neural damage to the lower extremities. He was evaluated with an electromyoneurography test, ultrasonographic examination of the lower extremities, and had 2 rounds, 10 days each, of a physical exercise routine, for a total of 20 days. After the exercise routine, his status was somewhat improved but the electromyoneurogram showed a motor and sensory lesion of the tibial nerve, bilaterally, and the ultrasonogram showed scar formation in both injured muscles. At his most recent examination on February 16, 2011, his state was somewhat improved, but residual nerve and muscle damage to the right thigh and the left lower leg remained, and he noted that he feels occasional numbness in the left lower leg and mild pain in the right thigh. This condition is considered final without likely further improvement.

CASE 6

A 62-year-old hunter was attacked by a wild boar during a drive hunt on November 15, 2010, around 8:30 AM. He sustained a bite wound to the left lower leg with local muscle tearing. First medical treatment was given on site by the emergency medical team, and he was transferred to the regional university hospital where he was treated as an outpatient. The bite wound was explored, cleaned, drained, and sutured; and he was administered a tetanus toxoid booster, rabies post-exposure prophylaxis and dual antibiotic therapy—cefuroxime, 500 mg twice a day, and metronidazole, 500 mg three times a day, for the following 10 days. He had several follow-up examinations until December 31, 2010, when treatment was completed; he recovered fully and without any complications.

CASE 7

A 46-year-old gamekeeper was attacked by a wild boar during a tour of the hunting grounds on March 1, 2011, at approximately 11:15 AM. He sustained a large superficial bite wound with skin tearing to the left side of the back that spread from the T₈ vertebra to L₃ vertebra, an area of approximately 20 cm × 10 cm. He received initial medical treatment on site by emergency medical team, and they transferred him to the local general hospital where he was kept for hospital treatment. The wound was cleaned under general anesthesia, and he was administered a tetanus toxoid booster, rabies post-exposure prophylaxis, and dual antibiotic therapy—amoxicillin plus clavulanic acid, 1000 mg (875 mg amoxicillin + 125 mg clavulanic acid), twice daily, and metronidazole,

500 mg, three times a day, for the following 7 days. He was kept in the hospital until March 7, 2011, when he was released home. He recovered completely and without any complications.

Discussion

Wild boars, the most common attacking animals in our study (5 of 7 attacks [71.4%]), have a typical attack pattern that results in a localized pattern of injuries on humans. They first charge and bite, often from behind, resulting in injuries to the lower extremities; and if the assault continues and the victim is knocked to the ground, more dangerous and severe secondary lesions may occur in any anatomic location depending on the relative position of the victim and attacking animal.¹⁸ These secondary injuries, which can be very serious or even fatal,^{4,7} were not present in our series.

Nearly all of our 7 injured hunters recovered completely and without significant complications. All who sought medical attention received timely emergency and surgical treatment as well as immediate vaccination (tetanus toxoid booster, rabies post-exposure prophylaxis) and single or dual antibiotic therapy, as recommended by some authors.^{18,19} The ultimate outcomes of animal-inflicted injuries can be affected by the timely application of initial first aid and resuscitation. In Croatia, first aid education is not part of the mandatory education course for hunters, unlike in other European countries; we propose that this be incorporated into the obligatory education curriculum for hunters and gamekeepers in Croatia to improve field treatment and on-scene management of animal inflicted injuries.

Most superficial injuries with minimal depth of penetration can be managed with simple wound care by local practitioners. Deeper or more severe injuries that may require surgical exploration should be transferred to a hospital environment where this is available. Deep penetrating injuries, which have higher risk for developing infections, and severe life-threatening injuries demand a multidisciplinary hospital approach including surgeons, microbiologists, neurologists, and rehabilitation medicine specialists to achieve the best recovery possible with good cosmetic and functional results. Of course, there are many more variables that need to be taken into consideration besides just the depth of penetration, so a thorough examination of the injury and the patient's complete health state as well as the animal species and the individual animal (if it is caught or killed) must be conducted. The wound must be cleaned, followed by debridement, and then by a thorough wound exploration to seek out all potential injuries to anatomical structures (muscles, tendons, blood

vessels, and nerves).²⁰ A high-risk patient with comorbidities will require a more thorough evaluation and potentially more aggressive treatment than that needed for an otherwise healthy person.

The use of prophylactic antibiotic treatment of wild animal bites is based on experience gained from treating domestic animal bites,²¹ but most experts recommend their use for high-risk cases, especially when primary closure of the wound is performed.^{18,19,22} The choice of antibiotics for treating animal bite wounds should be based on considering all potential pathologic microbial agents present in the animal's oral cavity and the victim's skin. However, there are few data available about oral flora of some wild animals. It is reasonable to assume that wild boar oral flora may be similar to that of domestic pigs, and therefore may include *Staphylococcus* spp, *Streptococcus* spp (including *S. sanguis*, *S. suis*, and *S. milleri*), diphtheroids, *Pasteurella multocida* and other *Pasteurella* spp, *Mycoplasma*, *Haemophilus influenzae*, *Actinobacillus suis*, *Flavobacterium* group IIb-like organisms, *Bacteroides fragilis*, and other anaerobic gram-negative bacilli.^{23–26} Amoxicillin plus clavulanic acid or a combination of ciprofloxacin with co-amoxiclav is recommended for the prophylactic treatment of pig bites.^{24,25} For extremely high risk cases, intravenous benzylpenicillin, fluoxacillin, and metronidazole, together with ciprofloxacin orally are advocated.²⁵

Primary closure of animal bites leads to faster wound healing, shorter recovery time, and better aesthetic outcome, but may increase potential risk for wound infection. Proper selection of primary versus delayed closure should take into consideration the relative risk, including characteristics of the wound itself as well as the time passed from wounding to treatment, the injured person's health state, and potential infective microorganisms that can be found in the attacking animal's oral cavity.

As evident in our second case and fourth through seventh cases, in which our victims had penetrating injuries inflicted by a wild boar, the surgeons opted for primary closure where sutures were necessary and antibiotic therapy for 7 to 10 days, unlike the recommended prophylactic therapy for 3 to 5 days. A longer duration of antibiotics as a treatment dose was chosen over prophylactic doses because the risk of infection in primarily closed animal wounds is greater than in those allowed to heal by secondary intention. Because none of our victims had infections after primary closure combined with immediate therapeutic antibiotic therapy and had fast recovery with great cosmetic and functional outcome, we would suggest further research into this treatment protocol as a potentially widely accepted treatment strategy.

After a retrospective review of game animal attacks on hunters during a 13-year period in Croatia, we can conclude that these occurrences are rare and suggest that, in this respect, hunting in Croatia is safe compared with hunting in some other countries, such as Kashmir, where 203 animal attacks occurred during a 3-year period (2005–2007);² Alberta, Canada, where there were 42 reported fatal and serious injuries to humans by bears over a 38-year period (1960–1998);⁹ British Columbia, Canada, with 72 reported fatal and serious injuries over a 37-year period (1960–1997);¹⁰ Tanzania, where 871 lion attacks were registered during a 15-year period (1990–2005);¹¹ South Africa, where 7 tourists were killed by wild mammals during a 10-year period (1988–1997);⁶ and in the United States, North Carolina reported 92 deaths in the 17-year period from 1972 to 1989.³ In our series, there were no fatalities, and the game attacks resulted mostly in soft tissue injuries, from which most of the victims recovered completely. Game animals do not generally pose a threat to humans in Croatia, but hunters should be aware of the possibility of attacks, especially during the busy hunting season between November and January.

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