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**PATHOLOGY/BIOLOGY**

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## A Unique Fatal Moose Attack Mimicking Homicide\*

**ABSTRACT:** Fatalities caused by animal attacks are rare, but have the potential to mimic homicide. We present a case in which a moose attacked and killed a woman who was walking her dog in a forest. Autopsy showed widespread blunt trauma with a large laceration on one leg in which blades of grass were embedded. Flail chest was the cause of death. The case was initially conceived as homicide by means of a riding lawn mower. A review of the case by moose experts and analyses of biological trace material that proved to originate from moose, established the true source of injury. The dog probably provoked a moose, which, in response, stomped and gored the victim to death. The injuries resembled those previously reported from attacks by cattle and water buffalo. Fatal moose attacks constitute an extremely rare threat in boreal areas, but can be considered in traumatic deaths of unknown cause.

**KEYWORDS:** forensic science, forensic pathology, traumatic death, animal attack, moose

Fatalities resulting from interaction with nonvenomous animals are relatively infrequent in the northern hemisphere but constitute a significant portion of potentially preventable deaths caused by animals. Special forensic problems posed by such cases include their potential to mimic homicide (1). In the U.S.A., an annual average of 121 fatalities were caused by injuries after an attack by a nonvenomous animal, correlating with an annual incidence of 0.42 deaths per million inhabitants. The most common specified species involved was dogs, causing 23% of these deaths, whereas “other mammals” constituted 60% (2). In Sweden, the annual incidence of deaths related to nonvenomous animals was 5.8, correlating with 0.67 deaths per million inhabitants, of which riding a horse or a horse-drawn vehicle constituted the largest share (2.2 deaths/year). Aggressive cattle were the single most common cause with an annual incidence of 1.6 (3). Characteristic autopsy findings in deaths due to butting and kicking by large farm animals are blunt force injuries to the head and chest in which imprints from hooves may be seen, whereas penetrating injuries from goring are rare (1). One-third of the victims show involvement of multiple body regions (4). In an analysis of seven deaths and 23 injuries arising from bull attacks, the main fatal injury was situated in the thorax of five (71%) victims. Among the survivors, the main injury was

localized to the abdomen or to the thorax (5). In a recently published case of a fatal water buffalo attack, crush injury of the torso with flail chest and a deep degloving injury of one arm compatible with goring were the most prominent injuries (6).

Moose rarely resort to violent behavior and are rather known for their docile temperament, and human deaths resulting from interaction with moose are almost exclusively the result of a motor vehicle collision (7). Nonetheless, incidents of moose attacks have been reported, many of which involved a moose cow, protecting its calf in the summer, or a bull in the mating season in the fall. Loose dogs have been suggested to provoke moose in these situations (8). Fatal moose attacks have not, to our knowledge, been reported in the scientific literature previously. Here, we present a unique case of a fatal moose attack.

### Case Report

A woman in her sixties had gone out during the evening to walk her dog in a rural village in Sweden, and when she did not return, her spouse went out to look for her. Later in the evening, she was found dead in a nearby forest by the shore of a lake. At the scene, the body lay supine at the bottom of a sloping path leading to the lake, roughly 1–2 m from a rowboat that was stored upside down. The ground surrounding the body showed trampled and flattened grass that was partly covered with fresh soil, interpreted as being caused by rescue workers and police officers. A detailed inspection of the ground was additionally somewhat complicated by a heavy rain. Beside the body lay a wooden log in fragments—presumably used as a boat rest. The decedent’s shirt and jacket were positioned such that the abdomen was exposed. Her jeans had an anterior longitudinal gaping tear of the right leg extending from the hip to above the ankle and another posteriorly located tear, extending from the torn waistband to the knee (Fig. 1). The fringed edges of the tears were partly tucked into deep lacerations on the right leg.

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FIG. 1—The victim's trousers were torn from the waistline down.

A preliminary inspection of the body showed signs of trauma, including extensive and deep wounds on the right thigh and leg, exposing the musculature. The wounds were initially interpreted as being due to sharp rather than blunt force trauma. Considering these injuries, the amount of blood at the scene was viewed as minimal. Consequently, the scene was, at this point, thought to represent a dumping site rather than the death scene. A few loose strands of hair, not believed to belong to the victim, were retrieved from the left eye region and the neck.

The findings led to the preliminary conclusion that the woman had been killed by means of a vehicle or other machinery. A riding reel lawn mower owned by a suspect was thought to be the source of her injuries.

### The Autopsy

Before the autopsy, a full-body CT scan was performed, revealing pneumothorax on both sides, a thin right-sided subdural hemorrhage, multiple rib fractures, and fractures of all right-sided transverse processes of the lumbar spine and of the right tibia and fibula.

The external examination showed several relatively superficial abrasions and contusions on the head and face, especially on the left side. A few conjunctival and oral mucosal petechiae as well as a laceration of the tongue were seen. Moreover, widespread contusions and superficial abrasions on the whole of the body were seen. A noteworthy, 0.9 cm in diameter, round, more than 1 cm deep wound and a 5 cm long laceration were seen on the



FIG. 2—The outer aspect of the right upper arm, showing a 0.9 cm in diameter and more than 1 cm deep, circular wound and a 5 cm long laceration.

outer aspect of the right upper arm (Fig. 2). The most prominent external finding included a few deep lacerations, up to 30 cm long, on the outer aspect of the right thigh and leg with large uneven skin flaps and fringed edges, and with grass embedded deep into the lacerated musculature (Fig. 3). The surrounding soft tissues exhibited avulsion, i.e., dissociation of subcutaneous fat and underlying muscle fascia. A conspicuous horizontal, almost band-shaped, 12 cm wide contusion was seen posteriorly on the central torso (Fig. 4).

The internal examination confirmed bilateral flail chest (Fig. 5). Extensive contusions were found in the gluteal muscles. Soft tissue hemorrhage in the diaphragm and small contusions in parenchymatous abdominal organs were also seen with minimal intraperitoneal bleeding. Apart from the injuries, chronic pulmonary emphysema, multinodular colloid goiter, and a Hürthle cell adenoma were present. The cause of death was determined to be flail chest.

### Forensic Investigations

Blood stain pattern analysis on the hull of the rowboat indicated that the victim had been hit/struck numerous times close to the boat.

The strands of hair that were retrieved from the victim at the scene were subjected to microscopic morphological analysis at the Swedish National Forensic Centre in which comparison between the hairs and a reference database was made. The method is not particularly species-specific but quite sensitive in that it allows one to ascribe the sampled hair to a certain group of species, in this case a cervid (Cervidae). This finding caused some speculation that the woman had been dumped by a tractor which previously had been used for transporting a moose carcass during the annual moose hunt.

When the riding reel lawn mower, after analysis and testing, had been excluded as the cause of the injuries, the prominent grass-containing injuries on the lower extremities raised the question whether they were instead caused by a wild boar. Consulted physicians and veterinarians with experience regarding wild boar hunting injuries on humans and dogs concluded, however, that even if the injuries on the lower extremities could have been caused by wild boar, it was highly improbable that a wild



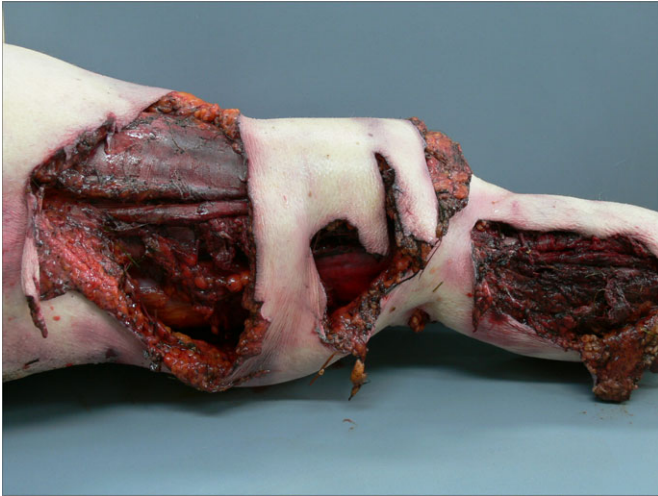


FIG. 3—Multiple lacerations of the right leg. Grass was found deep in the wounds.

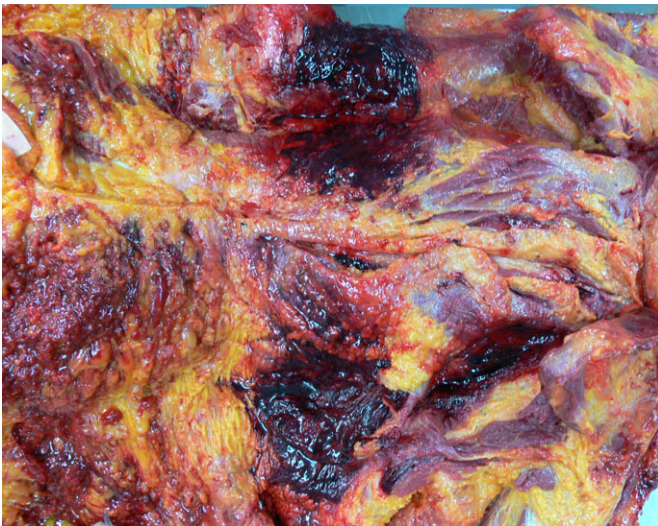


FIG. 4—A band-like contusion was seen running horizontally over the posterior torso.

boar would have continued the attack toward a person lying down, with extensive injuries also on the torso.

A subsequent analysis of the cervid hair was made in which specific mitochondrial DNA regions, with well-documented interspecies variations, were deciphered and compared with an existing database. The method is highly specific and led to the conclusion that the hair originated from moose.

To explore the possibility of a moose attack, the investigators consulted with specialists at the Swedish University of Agricultural Sciences. Their conclusion was that the injuries most likely were the result of a moose attack and that the scenario might have been the following: The woman was walking the unleashed, young dog when the dog came across a moose and returned to the woman, seeking her protection. Probably, the moose pursued the dog, knocked the woman over, and killed her by stomping, kicking, and goring. As the incident took place right before the rutting season, aggressive behavior and attacks on humans could be expected and has been documented in which the moose lowers its head, gores the victim, and kicks it with the forelimbs (9). The moose specialists suggested that if

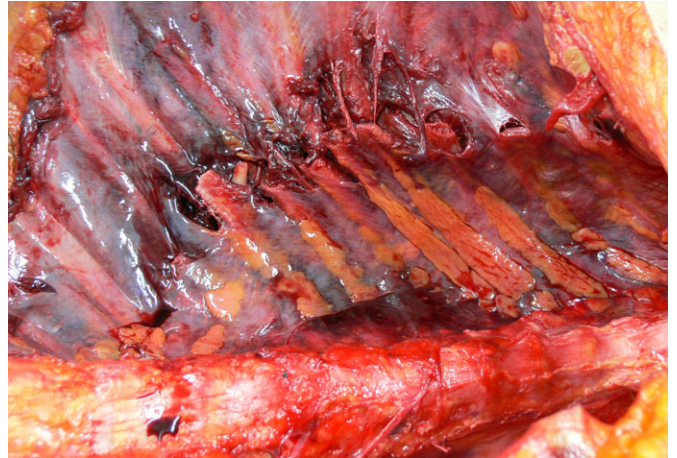


FIG. 5—The inner aspect of the right thoracic wall reveals multiple rib fractures and tears in the parietal pleura.

this was the case, moose saliva should be found on the victim's clothes.

At the Swedish University of Agricultural Sciences, DNA was extracted from numerous stains on the victim's shirt and jacket. This was compared with moose-DNA through PCR with moose-DNA primers (10). All of the sampled stains were revealed to contain relatively large amounts of moose-DNA.

The force required to tear the victim's waist line was determined with a tensile force tester (Instron® 4446- Manufactured by Instron, Norwood, Massachusetts, USA). Five, new and unused, identical trousers of the same brand as the victim's trousers were tested. Repeated tests were performed, with a pulling velocity reaching 500 mm/min. The force required to tear the trouser's waistline was determined to exceed 953 N.

## Discussion and Conclusion

The band-like contusion on the trunk was consistent with a heavy stomping or crushing force applied while lying against the previously mentioned wooden log, which correlated well with the size and form of the contusion. The somewhat specific wounds on the right upper arm might have been the result of stomping with a hoof. A likely reason for the sparse amount of blood on the scene could be that the external injuries were caused after the circulation had ceased and/or that blood around the body had infiltrated the ground during the heavy rain. Finally, the force required to tear the victim's waist line is rather extensive and roughly corresponds to her being lifted briskly off the ground by the trousers' waist line. It is thus plausible that the moose's antlers got caught in the trousers during the attack with subsequent forceful pulling by the animal. The manner of death was considered to be accidental, due to a moose attack.

Our case exemplifies the difficulties posed by an unwitnessed fatal animal attack. The complex trauma picture displayed can occasionally mimic foul play by means of a heavy tool, or a fall if the body is found next to a height. The injury pattern in our case bears clear resemblance to a recently reported case of fatal water buffalo attack (6). It even resembles those previously reported from attacks by cattle (4,5), with the addition of extensive blunt tearing and penetrating force as well as avulsion type injuries—probably due to goring. Fatal moose attacks constitute an extremely rare threat in boreal areas, but can be considered in outdoor traumatic deaths of unknown cause.

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