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Death Investigation: Does Post-mortem Scavenging by Animals Always Make it Difficult?

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Abstract - Animal scavenging activity on human corpses plays an important role in maintaining the food chain. However, when human bodies are found outdoors, scavenging activity by animals often affects the death investigation process. Scavenging by Asian water monitors (*Varanus salvator salvator*) on human corpses is relatively common in Sri Lanka. Here, we present an unusual case where eight deceased *V. s. salvator* found at the site of a 51-year-old man's scavenged body helped determine the probable cause and circumstances of his death.

Introduction

Animal scavenging activity on human corpses plays an important role in maintaining the food chain and constitutes an integral part of the taphonomic process experienced by the body after death (Saukko & Knight, 2004; Tsokos, 2005). Many animal species belong to this food chain, and the odors pervading from human corpses due to the natural putrefaction process can attract the attention of many species, including the Asian water monitor (*Varanus salvator*) (Colard *et al*., 2015).

When a body is found outdoors, the effects of scavenging by animals can affect the death investigation process. Corpses may be attacked by many scavenging animals and exposed to complete destruction, with the bones and belongings of the individual scattered over a large area (Beck, 2015; O'Brien, 2015). If the corpse is immersed in water, many aquatic animals such as fish, water rats, crabs, and amphipods may attack the body (Jones, 1998; Petrik, 2004; Dumser & Türkay, 2008). If the corpse is in shallow water, additional terrestrial species may scavenge on it as well.

Varanus s. salvator is widely distributed throughout Sri Lanka where it prefers aquatic habitats in wet, dry, and intermediate zones up to elevations of about 1000 m (De Silva, 1996; Gaulke & De Silva, 1997; Karunarathna, 2008). It is an opportunistic generalist carnivore that predates and scavenges on a wide variety of species including fish, amphibians, rodents, birds, reptiles, and large invertebrates such as crustaceans (Karunararhna, 2015). Scavenging by *V. s. salvator* on human corpses is a fairly common occurrence in Sri Lanka (Gunawardena, 2016; Gunethilake & Vidanapathirana, 2016).

Generally, post-mortem scavenging on human bodies raises many medico-legal issues including identification and injury interpretation, and many published case reports and reviews have addressed these issues (Gunethilake & Vidanapathirana, 2016). However, it is rare for animal scavenging activity to aid in determining the presumed cause and circumstances of death. Here, we describe a case of post-mortem scavenging activity by *V. s. salvator* that led to the discovery of a probable cause of death of the individual.

Case History

A 51-year-old man from Kurunegala in the North Western Province of Sri Lanka with a history of insomnia and probable depression went missing on 6 December 2018. There was no information about his whereabouts for almost two weeks. Many people searched for the missing individual, but all efforts were unsuccessful and discontinued after 10 days. Twelve days after his disappearance on 18 December, the partly mutilated body of the missing individual was found by a roadside with shrubs nearby. The police initiated an investigation at the scene where the body was discovered.

The body was in an advanced degree of putrefaction

Fig.1. Body with an advanced degree of putrefaction and deceased *Varanus s. salvator* nearby.

Fig. 2. Bodies of three additional water monitors (*V. s. salvator*) lying close to the body.

with partial skeletonization of the face (Fig. 1). The body had apparent injuries, with both upper limbs partly missing. A multi-coloured sarong was seen over the lower limbs with black underpants in situ. Part of a decayed brownish shirt was seen tucked under the body. The skin was sloughing off the abdomen. There were several dead flies seen on the body of the deceased.

The bodies of five deceased *V. s. salvator* were found in the immediate vicinity of the body (Fig. 2). Body lengths of the dead water monitors were not measured, although all appeared to be adult individuals. Each of them was in a different stage of putrefaction. Further searching of the area revealed an additional three deceased *V. s. salvator* within the nearby shrubs. There were no signs of injuries on any of the water monitors found, although the heads of some of them were already putrefied. The discovery of several dead *V. s. salvator* raised a very likely possibility of a common cause of death which prompted another search of the area that turned up an empty bottle of Marshal 20 – liquid Carbosulfan, a common pesticide (Fig. 3).

Discussion

Post-mortem scavenging by *V. s. salvator* on human corpses is a known phenomenon in Sri Lanka (Gunawardena, 2016; Gunathilake & Vidanapathirana, 2016). The odors pervading from the corpse usually attract various wild animals including water monitors (Colard, 2015). However, finding several deceased specimens in close vicinity to the human body and the presence of dead flies on the body raised the suspicion that some form of poisoning was involved. Further investigation yielded additional information, revealing that the victim purchased a bottle of Carbosulfan from a pesticide shop in the nearby town a few days before his disappearance. The body's advanced degree of putrefaction made it impossible to obtain samples for toxicology, but the absence of any injuries apart from scavenging indicated that the cause of death was non-traumatic in origin. A natural cause of death cannot totally be excluded, but the presence of eight dead water monitors in the vicinity of the corpse raised the possibility of a common cause of death.

Fig. 4. Pesticide bottle found at the scene.

Although animal scavenging usually renders investigations of death difficult, on this occasion the task was made easier by the scavengers. However, before arriving at a conclusion the observations and findings of this case must be carefully analyzed.

If the *V. s. salvator* in this case died as a result of some kind of poisoning, was it due to scavenging on the human body? Did the human body they are believed to have fed on contain a poison? The discovery of an empty Carbosulfan bottle in the vicinity and evidence of the victim buying it from the town makes it highly possible that the victim's death was due to self-ingestion of the pesticide. While most of the body remained intact, the upper limbs and tissues close to the axilla were devoured by scavengers. It is noted in many case studies where scavengers died following feeding on dead bodies that they were more likely to die after devouring the gastrointestinal tract and its contents (Allen *et al*., 1996).

Lizards can become exposed to insecticides both directly and indirectly. For example, lizards can inhale the insecticide, consume insects poisoned with the chemical, drink contaminated water, and absorb the insecticide through their skin. There is little information available on the susceptibility of lizards and other reptiles to pesticides (Hall & Clark, 1982). However, it is noted that reports of reptilian mortality events following pesticide applications are numerous enough to establish some sensitivity of reptiles to these chemicals (Hall & Clark, 1982).

Carbamate pesticides are used widely for agricultural and residential applications as insecticides and fungicides. Their worldwide annual usage is estimated to range from 20,000 to 35,000 metric tons (Muhammet *et al*., 2007). This family of chemicals has replaced organochlorine pesticides, which have been banned throughout the world (Muhammet *et al*., 2007). Unlike organochlorine pesticides, carbamate insecticides do not persist long in the environment, and they tend not to bioaccumulate (Muhammet *et al*., 2007). Nevertheless, carbamate pesticides can be toxic to non-targeted wildlife, with fish and birds appearing to be more sensitive to these pesticides than mammals (Grue *et al*., 1983).

There have been no local studies done to determine the effects of pesticides on reptiles in Sri Lanka, and most instances of scavenging by *V. s. salvator* on human corpses are unknown outside the forensic community. Therefore, the possibility of 'accidental' poisoning of these lizards by pesticides must be considered based on studies done outside Sri Lanka. Carbamate is a poison which uses a mechanism of action similar to organophosphate pesticides (Fukuto, 1990). Parsons (2000) observed the effects of organophosphate and carbamate pesticides on non-targeted wild animals, showing that these pesticides inhibited cholinesterase activity. Khan (2002) studied the effect of permethrin and biosal in the Indian Garden Lizard (*Calotes versicolor*) and reported that cholinesterase activity decreased following treatment with permethrin (Khan, 2002). Secondary poisoning of raptors has been documented in cases where Carbofuran was used on crops (Mineau, 1993; Elliot *et al*., 1996), and the compound has been used to deliberately poison raptors (Mineau, 1993, Mineau *et al*., 1999). Carbofuran has been shown to cause direct and secondary poisoning of animals for at least 60 days after agricultural application under autumn conditions in Kansas and may have persisted even longer under colder conditions (Allen *et al*., 1996).

Measurement of Anticholinesterase (AChE) activity is an accepted method for diagnosing poisoning by pesticides that affect AChE activity. In a study done in Canada where eagles fed on coyotes that died from carbamate poisoning, AChE activity was inhibited (Wobeser, 2004). This type of testing is currently difficult to perform in Sri Lanka, but had such testing been conducted on the dead *V. s. salvator*, it could have determined the cause of death and thereby confirming the possibility of carbamate poisoning. Brain AChE activity is commonly used to identify anticholinesterase poisoning, but the interpretation is difficult for specimens collected in the field because chemicals have a variable effect on AChE (Tattersall, 2018) and the level of exposure, time period, and conditions between death and specimen analysis are highly variable (Morais *et al*., 2012).

One important question remains. If the *V. s. salvator* fed only on the limbs of the deceased individual, does that mean the 'poison' ingested by the victim had already diffused into peripheral muscle tissues? This possibility would indirectly suggest that the victim lived for some time after the consumption of the poison, or that there was post-mortem diffusion of the chemical into peripheral body tissues.

Conclusions

Although scavenging by animals usually interferes with death investigations, in some rare instances it might be useful for determining certain important aspects of the case. Scavenging by *V. s. salvator* on human corpses is a common phenomenon in Sri Lanka. It would be useful if studies related to their actions could be carried out to obtain more confirmative data for future use in forensic investigations.

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