

Causes of sudden and unexpected death in dogs: A 10-year retrospective study

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Veterinary practitioners and pathologists are sometimes asked to examine animals that have been found dead without premonitory signs. A list of the common causes of sudden death is available for large animals (1–5), but, to the best of our knowledge, no such list exists for dogs. The causes of sudden death in dogs were reviewed by using postmortem records of the veterinary diagnostic laboratory at the Western College of Veterinary Medicine (WCVN), which is the only laboratory serving Saskatoon, a city of 219 056 people (6), and the surrounding rural areas of central Saskatchewan.

All records involving dogs over 6 wk of age during the 10-year period from July 1, 1989, to June 30, 1999, were reviewed. Cases selected for inclusion involved dogs that were found dead but were considered healthy by their owners when last seen. The owners, therefore, did not observe clinical signs. Deaths that were iatrogenic, including those associated with anaphylaxis and general anesthesia, or induced, as euthanasia, were not included.

Each case was reviewed to determine the underlying cause, month, year, and location (rural or urban) of the death, as well as the age, sex, and breed of the dog. In all cases, the description of the gross postmortem findings, the description of the histologic findings, if any, and the results of any ancillary tests were reevaluated to determine if they supported the original conclusions of the pathologist regarding the cause of death. Dogs were further classified by body type into 1 of the 7 groups used by the Canadian Kennel Club (7). The relative frequencies of the various causes of death were determined and the other variables were examined for trends.

One thousand, nine hundred, and thirty-three dogs were examined during the 10-year study period. Of those, 151 (7.8%) died suddenly and unexpectedly and are summarized by underlying cause of death in Table 1.

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Table 1. Underlying causes of sudden and unexpected deaths in 151 dogs

General cause of death	Number of cases	% of total
Heart disease	33	21.9
Toxicity	25	16.6
Gastrointestinal disease	20	13.2
Trauma	19	12.6
Hemorrhage not associated with trauma	10	6.6
Malnutrition or dehydration	8	5.3
Respiratory disease	6	4.0
Urogenital disease	5	3.3
Central nervous system disease	2	1.3
Peritonitis	2	1.3
Pancreatic disease	2	1.3
Undetermined	19	12.6
Total	151	100

The number of cases examined during each month and each year of the study was similar. The numbers of dogs from urban and rural areas were nearly equal. The dogs ranged in age from 6 wk to 14 y, with a mean of about 4.5 y. Seventy-six (50.3%) of the dogs were aged 4 y or less, and 41 (27.1%) 1 y or less. Fifty-nine (39.1%) of the dogs were intact males, 19 (12.6%) were castrated males, 46 (30.5%) were intact females, and 12 (7.9%) were spayed females; in 15 (9.9%) cases, the sex was not specified in the record. It was difficult to establish the breed of most dogs, since it could not be determined if an animal was truly purebred or simply resembled a purebred dog. One hundred and four (68.9%) dogs belonged to the herding, working, or sporting groups. Without similar data on the population of dogs present in the area served by the WCVN veterinary diagnostic laboratory, the implications of these findings are open to speculation.

Heart disease was found to be the most common underlying cause of sudden and unexpected death ($n = 33$). The most common types of heart disease were the idiopathic cardiomyopathies, 9 cases of the dilated form and 8 cases of the hypertrophic form. This finding is interesting, since, in general, the dilated form of cardiomyopathy is thought to be much more common than the hypertrophic form (8,9). Stenosis of the great vessels was diagnosed in 4 dogs and involved either the pulmonary valve, the aortic arch, or the subaortic area. Dogs diagnosed with stenosis of a great vessel ranged in age from 2 mo to 2 y, and the stenosis was presumed to be congenital. There were 3 cases of valvular endocarditis, each involving the aortic valve, due to mixed bacterial infections. One case involved *Pasteurella*

multocida, *Streptococcus* spp., *Clostridium perfringens*, and *Pseudomonas* spp.; another involved *Arcanobacterium pyogenes* and *Clostridium perfringens*; and a 3rd case involved *Streptococcus* spp. and *Staphylococcus intermedius*. Valvular endocardiosis, often an incidental finding at necropsy, was the primary lesion seen in 2 cases and was considered the underlying cause of congestive heart failure. The causes of myocarditis ($n = 2$), acute myocardial necrosis ($n = 2$), myocardial fibrosis ($n = 2$), and epicarditis ($n = 1$) were not determined.

The dogs dying suddenly and unexpectedly with heart disease were not unlike other dogs in terms of age, sex, and breed. Although most dogs diagnosed with heart disease were working dogs, all groups were represented, confirming that heart disease could potentially cause sudden death in any type of dog.

The 2nd most common underlying cause of sudden and unexpected death of the dogs was poisoning ($n = 25$), almost always due to strychnine (24 of 25 cases). Strychnine poisoning was confirmed in each case by analysis of stomach contents, tissues, or both. Cases of strychnine poisoning were diagnosed in 9 of the 10 y reviewed, with a range of 1 to 5 cases over those 9 y. Notably, 70.8% (17 of 24) of the dogs were from rural locations, while only 25.0% (6 of 24) were from urban areas. Affected dogs were 9 mo to 10 y old and tended to be intact males of the sporting and herding breeds, although many types of dogs were affected. There was also 1 case of carbon monoxide poisoning, which was diagnosed by information in the history and the bright red color of the tissues and blood, even after fixation in formalin.

Gastrointestinal disease accounted for 20 (13.2%) deaths. Among the deaths were 10 cases of gastric or intestinal displacements, including 7 dogs that had gastric dilation and volvulus. As would be expected, most of these dogs were deep-chested and large to medium in size. The remaining 3 cases included jejunoileal volvulus, displacement of jejunum through a defect in the mesentery, and gastric rupture followed by peritonitis. Nine dogs were diagnosed with enteritis caused by parvovirus. While it is possible that these dogs showed clinical signs that went unobserved, it is also possible that parvovirus can cause severe enough disease to cause death without premonitory signs. Eight of the 9 dogs with parvovirus enteritis were 1 y of age or less (with the age of 1 dog not recorded) and most (7 of 9) were intact males (1 was female; the sex of the other was not recorded). In 6 cases, the parvovirus was either isolated, identified with a fluorescent antibody test, or both, at the time of necropsy. In the other 3 cases (2 from 1991 and 1 from 1995), parvovirus was presumed to be the cause of enteritis based on the young age of the dogs and nature of the lesions. (For the purposes of this study, the presence of parvovirus was confirmed in these 3 cases by using an enzyme-based immunohistochemical staining technique on archived formalin-fixed, paraffin-embedded tissues (10)). *Clostridium perfringens* was responsible for the enterocolitis found in a 14-year-old dog.

Trauma was the 4th most common cause of sudden and unexpected death in dogs ($n = 19$). Over 84% (16 of 19)

of these cases had evidence of generalized or extensive trauma, which was presumed to be associated with a motor vehicle accident. This type of trauma was characterized by a combination of lesions, including displacement of an abdominal organ, ruptured diaphragm, ruptured spleen, ruptured liver, fractured bones, internal hemorrhage, and skin abrasions. In addition to these cases, there were 2 occurrences of gunshot wounds, as well as 1 case of fatal bite wounds in a small dog. More dogs from rural areas (57.9%) than from urban areas (36.8%) were involved in a traumatic event. The location of the traumatic event was not specified in 5.3% of trauma cases.

Hemorrhage not associated with trauma was the underlying cause of death of 10 dogs (6.6%). One-half of these deaths was associated with hemorrhage from a site of hemangiosarcoma, often located in the right atrium of the heart, the spleen, or both. When a tumor in the right atrium was the site of hemorrhage, blood accumulated in the pericardial sac, creating cardiac tamponade and contributing to death. When a site of hemangiosarcoma in the spleen was the source of hemorrhage, blood pooled in the abdomen and death resulted from exsanguination. As might be expected, dogs with hemangiosarcoma were older: 1 was 7 y, 1 was 11 y, and 3 were 12 y old. The other causes of fatal, nontraumatic hemorrhage were not determined. The 5 dogs in this group ranged from 3 mo to 13 y.

Surprisingly, malnutrition or dehydration was found to be the cause of death for 8 dogs. These deaths may not necessarily have been sudden, but the dogs were unexpectedly found dead. Six of the dogs were from urban areas. In 2 circumstances, 2 dogs were found together. All dogs were relatively young, ranging from 1.5 mo to 3 y. Four of these dogs were intact males and 4 were intact females.

Respiratory disease accounted for the death of 6 dogs. Included in these deaths were 4 cases of pneumonia affecting dogs from 2 mo to 5 y of age. The etiologies included *Streptococcus canis* and aspiration pneumonia. There were also 2 cases of asphyxiation involving a puppy with tracheal obstruction by a foreign body and a mature dog with compressed lungs, secondary to a diaphragmatic hernia. The diaphragmatic hernia was long standing and may have been associated with an accident that resulted in a fractured pelvis 20 mo previously.

Five dogs died of disorders affecting the urogenital system. Three of the 5 dogs died with metritis or pyometra, and the other 2 dogs died of the effects of urinary obstruction.

A relatively small number of dogs died of disease in body systems other than those already described. Specifically, 2 dogs had central nervous system disease, 2 others had peritonitis, and another 2 were diagnosed with pancreatic disease.

In over 12% (19/151) of cases, the cause of death was not established. In some instances, lesions were identified but were not considered life-threatening, while in other instances, no lesions were detected. These findings were not unexpected, as the cause of the sudden and unexpected death of horses was not determined in about 30% and 15% of horses by Brown et al (1) and Platt (4), respectively.

It is not known if the dogs included in this review represent all cases of sudden and unexpected death in dogs in the area served by the WCVM. There may be several factors that determine whether or not a dog that is found dead will have a postmortem examination. First, the cost of a postmortem examination may make it prohibitive or unwarranted to some owners. Yet, if there are other dogs at risk, an owner may be more willing to pursue an investigation of a death and request a necropsy. Although rare in our experience, a dog that is insured may require a necropsy in order to satisfy the insurer. If trauma is obviously evident, a necropsy may not be performed. Trauma may well account for more deaths in dogs, but if the incident had been observed or if the animal had been treated before it died, the dogs would not have been included in this study. When owners are concerned about the possibility of poisoning, it appears they want confirmation of such. Thus, it may be that cases of poisonings are over-represented, while some of the other causes of death are under-represented, in this study.

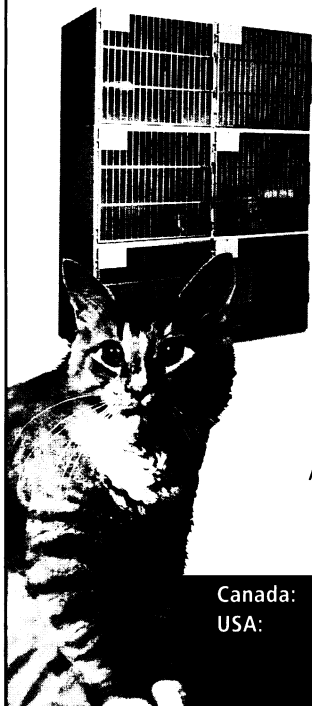
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