

Investigating peri-anaesthetic mortality

By Michael Hardcastle

Comparing postmortem findings in animals undergoing anaesthesia.



Death before, during or after anaesthesia is a distressing event, especially when it occurs in a young, apparently healthy patient undergoing anaesthesia for a routine procedure (eg, desexing). The cause is often unclear, and occasionally conversations between veterinarians and owners turn to the possibility of postmortem examinations, to find some answers and bring closure to these tragic events.

Several broad reports of peri-anaesthetic mortality can be found in the literature. However, postmortem findings are rarely reported; there is one recent major review of peri-anaesthetic mortality including postmortem findings in animals (DeLay, 2016). I thought it would be helpful to compare and contrast that review against postmortems I have conducted, so that veterinarians can learn from previous cases and understand the likelihood of specific diagnoses when submitting animals for postmortem examination.

Peri-anaesthetic deaths have multiple possible causes, including patient factors (eg, prior

to or post anaesthetic illness and congenital disorders), surgical complications and anaesthetic-related factors (eg, overdose, idiosyncratic drug reactions, hypoventilation, hypothermia, post-operative aspiration, hypotension, air embolism and myocardial depression/dysrhythmia). Some of these leave no pathognomonic gross or histological lesions at postmortem (DeLay, 2016; Gerdin et al., 2011).

In the DeLay review, 221 cases of peri-anaesthetic mortality submitted to the University of Guelph were analysed; these were mostly in dogs and cats, with 3.6% of all canine postmortems and 7.9% of all feline postmortems related to peri-anaesthetic mortality. Peri-anaesthetic mortality was defined as death within 24 hours of an anaesthetic or sedation. The highest proportion of deaths (45%) occurred in the post-anaesthetic period.

It was found that pre-existing disease had been recognised clinically in 31% of the animals, and that postmortem lesions of significant natural disease (pre-existing or post-anaesthetic) considered to cause or contribute to death were found in 59%, mainly involving the heart and respiratory tract. Cardiomyopathy in both species, aspiration pneumonia in dogs and pneumothorax in cats were the most common diagnoses in those organ systems. Lesions of sepsis, endotoxaemia and disseminated intravascular coagulation were common in animals with systemic natural disease.

Surgical or anaesthetic-related complications were identified in 5%; these consisted mainly of haemorrhage, although anaesthetic-related problems such as emphysema due to an incorrect anaesthetic circuit setting and accidental drug injection were identified. There were no lesions potentially causing or contributing to death in 37% of the animals; these were mainly considered young and healthy. Lesions due to cardiopulmonary resuscitation efforts were found in 34%; these were mostly pulmonary or multi-organ congestion,

TABLE 1. Cases of peri-anaesthetic mortality within 24 hours of anaesthesia necropsied by the author, 2012–2023. The causes/contributing factors are in bold, if identified. Cases with unclear diagnoses are filled yellow.

Age and species	Time of death pre/post anaesthesia	Surgical type – complication?	Anaesthetic complication?	CPR lesion?	Pre-anaesthetic disease?	Post-anaesthetic disease?	Indeterminate lesion?
Adult dog	1 day post	Dentistry – no	No	No	No	Aspiration pneumonia	No
Juvenile dog	1 day post	Desexing – no	No	No	Post-vaccinal canine distemper	Aspiration pneumonia	No
Adult dog	<1 day post (during recovery)	Skin mass removal – haemorrhage	No	No	No	No	No
Juvenile guinea pig	1 day post	Desexing – mesenteric ligature with intestinal infarction	No	No	No	No	No
Adult cat	<1 day post (during recovery)	Exploratory laparotomy – no	No	No	Intestinal obstruction and aspiration pneumonia	No	Probable pulmonary and intestinal freeze artefact
Adult dog	<1 day post (during recovery)	Fracture repair – haemorrhage	No	No	No	No	Probable pulmonary, hepatic, renal freeze artefact
Adult cat	<1 day post (during recovery)	Desexing – no	Possible anaesthetic-related pulmonary oedema	No	Possible heart failure	Possible asphyxiation (based on history)	Pulmonary, thymic, meningeal congestion and oedema
Adult dog	<1 day pre (after pre-medication)	Skin mass removal – no	No	No	Pulmonary neoplasia	No	No
Adult dog	1 day post	Cruciate repair – no	No	No	No	Probable sepsis and/or shock	Intestinal haemorrhage
Adult cat	<1 day post (during recovery)	Respiratory workup – spontaneous or iatrogenic pneumothorax	No	No	Feline asthma	No	No
Adult dog	<1 day post (during recovery)	Mammary mass removal – no	No	Possible adrenaline-related cardiac haemorrhage	Tracheal collapse, myocarditis	Pulmonary congestion and oedema	Hepatic congestion
Adult dog	<1 day post (during recovery)	Exploratory laparotomy – no	No	No	No	Possible acute lung injury	Pulmonary congestion, haemorrhage and atelectasis
Adult dog	<1 day (at procedure end)	Desexing – no	No	Possible compression-related diaphragmatic haemorrhage	No	No	Pulmonary, renal, splenic and intestinal congestion and/or haemorrhage
Adult cat	<1 day (during recovery)	Enucleation – haemorrhage	Possible blood aspiration	No	No	No	Probable pulmonary, renal freeze artefact
Adult dog	1 day post	Aural haematoma – no	No	No	Possible coagulopathy	Probable haemorrhagic diathesis	Multifocal haemorrhage
Adult cat	1 day post	Desexing – no	Probable spontaneous or iatrogenic pneumothorax	No	Possible cardiomyopathy	Possible traumatic pneumothorax	Probable pulmonary, renal, meningeal freeze artefact

haemorrhage and oedema, pneumothorax, pulmonary atelectasis and liver laceration.

In comparison, of the 285 companion animal postmortems I have conducted at Gribbles Veterinary Auckland since 2012, there were 16 cases of peri-anaesthetic death within approximately 24 hours of anaesthesia with an available history (table 1); 10/184 dogs and 5/80 cats represented 5.4% and 6.25% of all dogs and cats respectively. There were also five cases with longer timeframes than 24 hours in which mortality relating to anaesthesia and surgical intervention was still a consideration for the submitting veterinarians. I have not included those here, although in my opinion some complications (eg, aspiration pneumonia and gastroduodenal ulceration) may take longer than 24 hours to cause mortality.

It is difficult to explain the results of complex postmortem examinations from a summary like this, but several general comments can be made.

The only cases with prior knowledge of likely pre-existing disease were the cats with intestinal obstruction and feline asthma; the other pre-existing diseases were diagnosed on gross and histological findings.

The only cases with prior knowledge of likely pre-existing disease were the cats with intestinal obstruction and feline asthma; the other pre-existing diseases were diagnosed on gross and histological findings. Several cases of unequivocal surgical complications were also diagnosed. Case numbers are small to compare to DeLay, but nevertheless they reinforce the importance of pre-anaesthetic evaluation and careful surgical technique in preventing peri-anaesthetic mortality.

It is worth noting that no animals had a complete absence of lesions, as was common in the review. However, there were seven animals (44%) with probable or possible diagnoses, the vagaries of which were not discussed by DeLay; I suspect that DeLay may simply have classified cases with lesions of uncertain cause (eg, the dog with a possible coagulopathy) or multiple possible causes of death as cases of natural disease. Therefore, it

is important to warn owners that an aetiological diagnosis may not be reached, even if lesions are found. The reasons for this range from a lack of further testing (eg, histopathology) to an inability to perform some tests postmortem (eg, coagulation profiles) or a simple inability to diagnose some causes from animal remains (eg, asphyxiation during recovery, conduction abnormalities).

DeLay also did not highlight the effects of freezing on postmortem examination; this is known to produce artefacts such as tissue reddening due to red cell lysis, and apparent oedema due to increased extracellular fluid (Roe et al., 2012). This creates uncertainty in the assessment of key organs such as the lungs when determining whether there could have been significant pre-existing disease (eg, congestion, oedema, haemorrhage, inflammation), CPR-related changes or simply an artefact of freezing. In these cases, there were variable impacts on the interpretation of postmortem findings, but they did impair some investigations and owners should also be warned that prior freezing could reduce the diagnostic value of a necropsy. ¹⁹

Michael Hardcastle is an anatomic pathologist at Gribbles Veterinary.

REFERENCES:

DeLay J. Perianesthetic mortality in domestic animals: A retrospective study of postmortem lesions and review of autopsy procedures. *Veterinary Pathology* 53(5), 1078–86, 2016

Gerdin JA, Slater MR, Makolinski KV, Looney AL, Appel LD, Martin NM, McDonough SP. Post-mortem findings in 54 cases of anesthetic associated death in cats from two spay-neuter programs in New York State. *Journal of Feline Medicine & Surgery* 13(12), 959–66, 2011

Roe WD, Gartrell BD, Hunter SA. Freezing and thawing of pinned carcasses results in artefacts that resemble traumatic lesions. *The Veterinary Journal* 194(3), 326–31, 2012

