

Veterinary Forensic Pathology and Animal Welfare; an Introduction and the Post Mortem Examination

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One aspect of the veterinary profession which is often overlooked when considering animal welfare is the science of pathology. In this article we discuss the varied, often little-known, applications of veterinary forensic pathology, its application to animal welfare, and present an overview of the post mortem examination.

Veterinary Forensic Pathology

While the veterinarian can comment on the treatment of the live animal, the specialist forensic veterinary pathologist is able to comment on any disease or lesions in both the live and dead animal.

DiMaio and DiMaio⁴ introduce the definition and aims of forensic pathology as follows:

Forensic pathology is the branch of medicine that applies the principles and knowledge of the medical sciences to the many legal issues within the field of law... The medical examiner provides the expert testimony if the case goes to trial. Although all veterinary surgeons are trained to perform a basic post mortem examination, a forensic examination should always be performed by someone with additional postgraduate training and experience in veterinary pathology. This will prevent the court being misled by inexperienced interpretation of findings.

Typically, to become a qualified veterinary pathologist in the UK, the candidate must first complete their 5 to 6 year veterinary degree and become a member of the Royal College of Veterinary Surgeons (MRCVS), before completing an approved postgraduate pathology training programme (such as a

Residency, lasting 3 to 4 years) and undertake appropriate professional examinations. These might include one or a combination of the following: the Fellowship Examinations of the Royal College of Pathologists (FRCPath)⁵, the Diploma of the European College of Veterinary Pathologists (DipECVP)⁶, and/or the American College of Veterinary Pathologists (DipACVP)⁷.

Applications to Animal Welfare

Forensic pathology includes, but is not limited to, the investigation of dog attacks, animal sexual abuse, traumatic wounds to animals at scenes of homicide or other crimes, fires, neglected animals, and illegal hunting.

Recent developments, for example the amendments to the Dangerous Dogs Act in 2014⁸, have already resulted in an increased case load. The amendment now makes it an offence to permit a dog on your own property to attack anyone. Our department⁹ performed the post mortem examination of a dog in a case which became the first

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⁴ VJ DiMaio and D DiMaio, Forensic Pathology (2nd edn, CRC Press 2001), Foreword

⁵ <http://www.rcpath.org/training-education/specialty-training/veterinary-pathology> (accessed 13 April 2015)

⁶ <http://www.ecvpath.org/residency-training/> (accessed 13 April 2015)

⁷ <http://www.acvp.org/residents/Exam.cfm> (accessed 13 April 2015)

⁸ Dangerous Dogs Act 1991, amended 2014 <http://www.nawt.org.uk/advice/changes-dangerous-dogs-act-advice-owners> (accessed 13 April 2015)

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prosecution since the amendment to the Act came into force.

Unfortunately, due to these amendments to the Act happening so recently, we are not permitted to divulge details of these cases whilst they are ongoing, however in future they may be useful to discuss in detail.

In the case of *Gray & Ors v. Royal Society for the Prevention of Cruelty to Animals (RSPCA)*¹⁰ over 100 sick, dead, diseased and malnourished horses and ponies from a farm in Amersham in Buckinghamshire were seized by the RSPCA on the allegation of animal cruelty contrary to sections 4 and 9 of the Animal Welfare Act 2006¹¹. The defendants were tried and convicted. Appealing their convictions in Aylesbury Crown Court, only two of the eleven appeals were dismissed.

At Aylesbury, the prosecution's expert witness, reporting the post mortem findings, was highly praised by Judge Tyrer¹²:

"[The RSPCA's expert] was another outstanding witness. His grasp was total; his expertise was as abundant as it was obvious. We have no hesitation in accepting what he said to us. He destroyed the contrary arguments... Their [the appellant's professional witnesses] evidence cannot begin to compete with the vast array of other better argued and better researched evidence that we have heard. To us they have both attempted to open new avenues of exculpation as old ones ceased to be tenable. They lost their objectivity

and impartiality in the process. We are entirely satisfied that we must reject their efforts and we do so."

By the time a cadaver reaches the pathologist, intervention is too late for that individual animal, but successful identification of signs of abuse can result in prosecution and prevent repeat offences, or even raise concerns of domestic violence or child abuse in some cases¹³.

In cases of neglect or underlying health problems in groups of animals, such as herds, the pathologist's report on an individual animal can identify and result in resolution of the problem for the remainder of the group. For example, if a number of calves start dying in a herd, post mortem examination can elucidate the cause of death and provide the veterinary surgeon with a diagnosis (e.g. pneumonia) for choice of appropriate treatment and changes in management in that herd to prevent further deaths.

In all cases it is important to separate findings caused by natural disease from those due to abuse, however it may be that natural disease caused unnecessary suffering as a result of the animal's caretaker failing to seek veterinary attention. An example would be allowing a large tumour on the jaw to grow to the point it prevents the animal eating without seeking veterinary attention.

The Post Mortem Examination¹⁴

Post mortem refers to the time after death, ante mortem refers to the time before death, and agonal refers to the time immediately surrounding death (pre-mortem should not be used synonymously to ante mortem as it refers to a business strategy in which one analyses the reasons for a business project failing. The term is often mistakenly used in medical television series!)

The information obtained from a post mortem examination (PME) or necropsy varies according to the specifics of each case. It is of utmost importance to know why the PME is being performed to ensure appropriate samples are taken at the time of the examination and to ensure the instructions to the pathologist are addressed in the final report.

PME can ascertain cause of death, approximate post mortem interval (time since death), whether the animal was likely to have suffered, facilitate collection of trace and ballistics evidence (in co-operation with relevant Scenes of Crime Officers or other suitably qualified professionals), collection of samples for toxicological and microbiological analyses, document injuries or presence of underlying disease, or evidence of previous disease or trauma, and assist in collection of measurements for dog breed experts.

Questions often asked of us include: Were wounds caused by trauma, non-accidental injury or fighting? Are there signs of neglect? Is there evidence of sexual abuse? The

¹⁰[2010] EW Misc 8 (EWCC) <http://www.bailii.org/ew/cases/Misc/2010/8.html> (accessed 09 April 2015)

¹¹Animal Welfare Act 2006 s. 4 and s. 9 <http://www.legislation.gov.uk/ukpga/2006/45/contents> (accessed 13 April 2015)

¹²[2010] EW Misc 8 (EWCC) <http://www.bailii.org/ew/cases/Misc/2010/8.html> Page 78 and 125 (accessed 09 April 2015)

¹³<http://www.thelinksgroup.org.uk/site/understanding.htm> (accessed 14 April 2015)

¹⁴The post mortem examination may also be called the necropsy or autopsy.

pathologist, who is an expert in diagnosis, is able to address whether an underlying disease is present and whether it contributes to, or confuses interpretation of, other lesions. Likewise, the pathologist can identify changes caused by artefacts of storage, such as freezing of the cadaver, and decomposition. There is no single correct method to perform a PME. However, the pathologist should approach each case in a consistent manner to ensure all body systems and organs are examined and the appropriate samples are taken.

During the PME, the pathologist keeps notes of normal, incidental and abnormal findings. Sometimes questions can be answered following this examination alone. However, microscopic examination of the samples of fixed tissues (called histopathology), together with results from other testing (such as microbiology) can provide additional information in many cases. This information typically includes identification of disease processes not visible to the naked eye, and identifying the presence of microorganisms which might have contributed to the disease or lesion in the animal. These findings are all interpreted and presented in a written report by the pathologist when all examination and testing is

complete, together with photographs, and any information provided to the pathologist regarding clinical history and circumstances surrounding the case.

The approach to the post mortem examination, from receipt of the animal to completion of the report and giving evidence in court, as performed by the authors and colleagues is typically as follows.

The duty pathologist will receive communication that an animal for post mortem examination is to be delivered to the department. At this time there may be no additional information, but can sometimes include detailed clinical history or circumstances of death in advance of the arrival of the animal.

Regardless of the information received in advance of arrival, a member of the pathology staff will converse with the RSPCA or Police officer responsible for the case or responsible for the body (as a piece of evidence) to establish the events leading to death and the reason for the post mortem examination in the same way as a solicitor will take instruction from his client.

It is important to note at this juncture, that the pathologist's role in a case involving animal cruelty or neglect is to advise the court. Regardless of whether he is engaged on behalf of prosecution or defence, his/her evidence is impartial and is simply a statement of fact and opinion drawn from his/her expertise.

Chain of custody/evidence is the sequential documentation demonstrating the seizure, custody, control, transfer, analysis, and disposition of evidence. In order to maintain the critical chain of

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evidence the submitting officer will receive a receipt which includes the RSPCA log number or Police reference number, the Officer's name and contact details, details of the wrappings, including tag numbers if present, and signatures from both the person delivering the cadaver and the person receiving the cadaver on behalf of the pathology department.

The cadaver is assigned a unique reference number and then placed in secure refrigerated storage if the post mortem is not going to occur immediately upon receipt. A case file, with the unique identifier, is assembled to document cadaver receipt, hold notes from the client briefing, details of storage and imaging, hold notes of the examination, communications, and any other materials from a case. Ultimately this file will contain the final report and a CD of images upon completion.

If the cadaver is received frozen then it will be placed in a secure location for defrosting. Before the cadaver is removed from its wrappings the material received is photographed and recorded. If radiography, including computed tomography (CT scanning), is indicated then the cadaver remains in its wrappings and remains in sight of the pathologist or forensic technician for the entirety of the imaging process.

As the cadaver is unwrapped, notes are taken of any items which may accompany the cadaver within the wrappings. Also worthy of note are presence of fluids (for example blood

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and other discharges), invertebrates, including parasites (for example fleas and flea dirt), and/or flies and fly larvae. These are collected, documented and stored as appropriate. The presence of parasites might be contributory to disease, or neglect, and larvae may be useful in estimating the time since death.

Photographs are taken throughout the process as a visual record to support the documentation, and to present the material in court. When photographs are taken a scale with the unique identifier is placed in the field of the image in the plane of the area of interest. Photographs of the cadaver from each side are taken before the examination is started. In subsequent photographs the area of interest is photographed in context with the rest of the cadaver to assist the reader of the report, then a close-up is taken for detail. Scale bar(s) are placed in the appropriate plane of the image to allow measurements to be taken from the photograph at a later date if necessary.

The cadaver is weighed, measured and the exterior examined initially. Quality of the hair coat, claws or hooves, presence of parasites, state of decomposition, lesions such as lacerations, puncture wounds and bruises, prominence of bones, discharges from orifices or wounds, fractures, amongst other changes are recorded. Samples may also be taken and logged at this stage by Scene of Crime Officers (SOCOs) for further analysis, for example swabs from the mouth, feet and orifices for DNA. All these samples are recorded by the SOCO in an evidence log to maintain chain of custody when the samples move to another lab for analysis. Other measurements may also be taken at this stage, for example breed

experts may assess parameters for identification of banned breeds.

The veterinary post mortem, unlike the human equivalent, is not cosmetic. The dissection is extensive to allow examination of everything without fear of compromising the aesthetics of the cadaver, which is often disposed of by cremation when the case is closed (and with written permission from the responsible Officer).

Upon completion of the external examination, with the animal on its back (or on its side in the case of horses and cattle) the limbs are reflected away from the body and the cadaver is skinned in its entirety. The presence of a hair coat often obscures bruises and other lesions,

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however, once skinned, the inner surface of the skin may reveal these in both the skin and often subcutaneous tissues. These are photographed and documented. The amount of subcutaneous fat is recorded as absent, scant, minimal, moderate or abundant as appropriate, and the cadaver is examined for signs of skeletal muscle atrophy (wasting). Lymph nodes are examined and sampled if abnormal.

The oral cavity is examined, including the teeth. Next the

abdominal cavity is opened by a midline incision and the abdominal contents are examined. The positions of the organs are checked; the presence of fluid (such as blood, adhesions, pus, intestinal contents or ascites) is measured and recorded. A small stab-incision of the diaphragm is made to ensure that negative pressure is present within the thorax (the absence of negative pressure may indicate air has managed to get into the chest cavity by some other means, including trauma).

The thorax is opened by cutting along the ribs, to expose the contents. Similar to the abdominal cavity, the contents of the thorax are examined for presence of fluids, adhesions, or foreign material. The hyoid bones (small bones in the neck which may be damaged during compression of the neck) are examined. The tongue is separated from the floor of the mouth and reflected towards the chest, whilst cutting along the roof of the neck. This allows the tongue, wind-pipe (trachea) and food-pipe (oesophagus) to be removed together with the lungs and heart. A cut at the diaphragm frees these structures, and this group of organs is called the ‘pluck’.

The duct between the gall bladder and intestine is tested by gently squeezing the gall bladder and checking that bile moves into the intestine. The spleen, liver and adrenal glands are each removed whole. The stomach and intestines are removed together, followed by the urinary bladder and kidneys, connected via the ureters. The reproductive tract is removed (if the animal hasn’t been neutered) at this point too. At no point are the organs opened before removal from the

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cadaver. They are laid out on clean boards for photographing and description of the external surfaces in the notes. Then each set of organs is opened and examined.

The brain is removed by sawing through the skull. If necessary, the spinal cord is removed by sawing through the vertebrae. Nervous tissue must be fixed in formalin before it can be cut due to its soft consistency. Fixing causes the brain and spinal cord tissue to become firm and thus easier to section for examination, and may take up to a week in larger animals. The eyes may be removed and fixed for further examination too.

Each organ system is then examined in turn, the external appearance described and then opened for examination and description of the interior. A section of each tissue is then placed in formalin for fixation.

The respiratory tract is opened, along the trachea and down into the lungs. A note is made of the contents (if any) of the larynx, trachea and lungs. When sections of lung are taken for fixation, the pathologist observes whether the tissue floats or sinks in the formalin, to give an indication of aeration of the tissue. The skull may be opened further to examine the nasal cavity if indicated. The thymus is examined if present (this organ regresses with age, thus is largest in young animals).

The sac around the heart, the pericardium, is removed and any fluid contents measured and

described. The heart is weighed to provide a weight as a percentage of body weight. Then the heart is opened to examine each of the chambers and valves. Measurements are taken of the wall thickness of each chamber, to provide a ratio for interpretation.

The oesophagus, stomach and intestines are opened along their length. Stomach contents may be kept for further analysis. This might include toxicological or DNA analysis in cases of dog attacks for example. Further samples may be taken for microbiological, virological, and parasitological analyses where indicated. The surface is then rinsed to allow observation of the lining of the tract. Representative sections are then fixed in formalin.

The liver and spleen are cut into partial thickness slices to allow examination of the inside of these dense organs for lesions which may not be visible from the surface. Samples of these organs are taken for fixation, together with the adrenal glands and any lymph nodes which appear abnormal. The capsule of the kidneys is removed and then the kidneys are bisected to examine the architecture. A sample of urine may be kept for further analysis. Sections of kidney and bladder are taken for fixation.

Other samples which may be taken include fat and frozen sections of organs for toxicological analysis or advanced microbiological techniques (such as PCR for specific pathogens) and culture. Swabs may be taken for microbiological analysis, and these can be performed in a sterile manner by searing the outside of the organ of interest, making an incision with a sterile scalpel blade, then inserting a sterile swab. This ensures that

contamination from the post mortem room does not affect the culture results.

Following the post mortem examination, the pathologist writes a report of all the findings. This systematic dissection ensures nothing is missed. Suspicious findings might include bruising in cases with no reported history of blunt force trauma (e.g. from a kick), and with no signs of diseases which might predispose to excessive bleeding (e.g. blood clotting defects). Another example of a suspicious lesion is failure of lung tissue to float which might indicate the air spaces (alveoli) no longer contain air. This may have many causes: they may never have inflated (in stillborn animals), have collapsed due to rupture, be filled with blood, be filled with inflammatory cells (in some cases of pneumonia), contain fluid (from heart failure or drowning for example), and any number of other reasons too!

The interim report is often called the gross report. The samples which have been fixed in formalin are left for 24 hours to ensure complete fixation. Then the pathologist selects representative samples of these tissues for histological processing, which involves embedding the tissue in wax blocks for sectioning. These

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very thin sections are cut with a microtome, melted onto glass slides, stained, and then examined microscopically. This is called histopathology. All the sections are stained with a standard staining protocol with haematoxylin and eosin. Additional stains are available to the pathologist to highlight different microscopic structures and chemical components of tissues. Advanced staining using antibodies can be used to label specific microbes or molecular components of tissues and is called immunohistochemistry. This may assist with identification of tumours and pathogens.

When the slides have been examined by the pathologist and any additional tests completed, the pathologist adds the findings to the report. This takes around four weeks from the date of the post mortem examination to complete. The report includes an interpretation and summary of the case. The details of the pathology report will be discussed further in a future article.

The final report, together with a CD of the images from the post mortem examination, is sent to the client. In some cases the final report will be exhibited in court. There are cases in which a further statement from the pathologist is necessary, and the pathologist may be requested to attend court as an expert witness. For example, new circumstances may have come to light which may raise further questions or alter the interpretation of the findings.

The remains from the PME are kept frozen until the case is closed and written permission has been received from the responsible officer to either dispose of the remains, or arrange collection of the remains for storage elsewhere. The glass slides, fixed

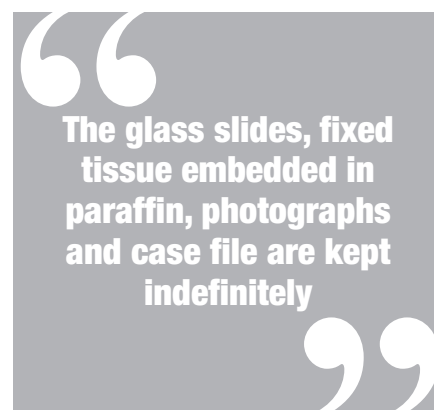
tissue embedded in paraffin, photographs and case file are kept indefinitely.

Conclusion

Veterinary pathology is the study of disease and underpins all of veterinary medicine. Veterinary forensic pathology is sometimes overlooked in animal welfare cases but the forensic post mortem examination can be a powerful tool in providing evidence in such situations. Forensic post mortems are not a routine procedure in first opinion practice and must be performed by suitably qualified persons if their findings are to be valid in court. The veterinary pathologist uses their expertise to address a number of questions which are often central to the case.

About the authors

Alexander Stoll became a member of the Royal College of Veterinary Surgeons in 2013, after obtaining a Bachelor of Veterinary Medicine from the Royal Veterinary College (RVC). During this degree he undertook an intercalated honours degree in Veterinary Pathology. He is currently in the final year of his postgraduate specialist pathology training (Residency) in Veterinary Anatomic Pathology at the RVC and has completed the first part of his examinations for obtaining Fellowship of the Royal College of Pathologists and the first part of his examinations towards becoming a Diplomate of the American College of Veterinary Pathologists. He is also undertaking examinations for the Diploma in Forensic Medical Sciences, regulated by the Society of Apothecaries. He is an Associate of the Royal College of Pathologists, Member of the Royal Society of Biology, Member of the Royal Society for Public Health, Member



of the British Veterinary and Forensic Law Association and a new member of the Association of Lawyers for Animal Welfare.

Gwen Fraser is a science graduate and experienced forensic pathology technician responsible for the administration of forensic cases and correlation of supporting evidence and maintaining the evidential chain. Currently studying for the LLB part-time and is a member of ALAW.

Simon Priestnall is a veterinary graduate from the University of Bristol (2004) and a member of the Royal College of Veterinary Surgeons, having completed an intercalated degree in Veterinary Pathology at the Royal Veterinary College (RVC). Following a PhD in canine viral pathogenesis he completed specialist postgraduate training in pathology at the RVC and is currently a Senior Lecturer in Veterinary Anatomic Pathology at the same institution. He is a Diplomate of the American College of Veterinary Pathologists (ACVP), holds the Fellowship of the Royal College of Pathologists (FRCPath), and is a Royal College of Veterinary Surgeons (RCVS) and American Specialist in Veterinary Pathology. He has also completed a Postgraduate Certificate in Veterinary Education, and is a Fellow of the Higher Education Academy.



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Glossary

Agonal – around the time of death

Ante mortem – before death

Autopsy – examination and dissection of a dead body

Biochemistry – analysis of body fluids for their chemical composition

Biopsy – sample of tissue taken from a living body for microscopic examination

Cytology – examination of individual cells under the microscope

Electron microscopy – use of an electron microscope (which uses electrons instead of light) to view structures smaller than individual cells, also called ultrastructural examination

Fixing – immersion of tissue in a fixative (typically formalin) to preserve it for further examination

Gastrointestinal tract – the digestive tract

Gross – visible to the naked eye

Haematology – examination and analysis of the blood

Histopathology – examination of thin slices of organs under the microscope

Macroscopic – visible to the naked eye

Microbiology – the growth, in a lab, of bacteria, fungus or virus from swabs or tissue taken from a body or object to identify the species of

bacteria, fungus or virus present in the sample

Microscopic – visible with the use of a light microscope

Necropsy – examination and dissection of a dead body

PCR – polymerase chain reaction; laboratory technique to amplify DNA samples for comparison or analysis

Post mortem – after death

Post mortem examination – examination and dissection of a dead body

Post mortem interval – the time between death and examination of the body

Responsible Officer – the RSPCA or Police officer in charge of the case, or given responsibility for the animals body as a piece of evidence

Toxicology – the analysis of body fluids, tissues or the contents of the digestive tract for identification of toxin