Review Article Pathology

Necropsy as an Important Diagnostic Step in Veterinary Pathology: The Past, Present, and Future Perspectives

Ochuko Orakpoghenor[1], Ashever Jocelyn Terfa[2]

[1]Department of Veterinary Pathobiology, Faculty of Veterinary Medicine, Bayero University Kano, Kano, [2]Department of Veterinary Pathology, College of Veterinary Medicine, Joseph Sarwuan Tarka University, Makurdi, Nigeria.

*Corresponding author:
Ochuko Orakpoghenor,
Department of Veterinary Pathobiology, Faculty of Veterinary Medicine, Bayero University Kano, Kano, Nigeria.

ochuko.orakpoghenor@gmail.com

ABSTRACT

Necropsy, or animal autopsy, is a cornerstone of veterinary pathology that serves as a critical tool for diagnosing the causes of death and understanding disease processes in animals. Historically, necropsy practices can be traced back to ancient civilizations, and the Renaissance period marked significant advancements with detailed anatomical studies. The 19th century further revolutionized veterinary pathology with systematic necropsy techniques and the emphasis on cellular pathology. In contemporary veterinary practice, necropsy remains a gold standard for diagnosing unexplained deaths and diseases. It plays a key role in public health by identifying zoonotic pathogens and preventing disease outbreaks. Necropsy is also crucial for wildlife conservation, helping to investigate mortality events and assess ecosystem health. In veterinary education, it provides essential hands-on experience for students, while in research, it offers specimens for studying disease mechanisms and developing new diagnostic methods. Future advancements in necropsy include the integration of digital imaging technologies such as computed tomography and magnetic resonance imaging, molecular and genetic techniques such as polymerase chain reaction and next-generation sequencing, and utilization of artificial intelligence. These innovations present potential toward transformation of the practice, thus making it more efficient and precise. Furthermore, ethical considerations and the standardization of necropsy protocols are essential to ensure the humane handling of animals remains and consistency in findings. In conclusion, as technology and scientific understanding evolve, necropsy will continue to be an invaluable asset in veterinary medicine, thus contributing significantly to animal health, public health, and educational and research advancements.

Keywords: Veterinary pathology, Necropsy, Diagnostic techniques, Zoonotic diseases, Technological innovations

INTRODUCTION

Necropsy, also referred to as animal autopsy, is an indispensable procedure in veterinary pathology which provides a comprehensive means to investigate the causes of animal mortality and to understand disease processes within animal populations.[1,2] The term necropsy originates from the Greek words "nekros," meaning dead, and "opsis," meaning sight, which together signify the examination of a dead body.[3] This procedure is fundamental not only for determining the cause of death but also for offering insights into the health conditions and disease dynamics that affect animal populations, both domesticated and wild.[4,5]

The practice of necropsy, or postmortem examination, has long been a cornerstone of veterinary pathology and offers invaluable insights into animal health and disease.[2] Historically, necropsy emerged as a crucial diagnostic tool in understanding the etiology and progression of various

ailments affecting animal populations. Through a thorough examination of the body after death, veterinarians and pathologists have been able to uncover hidden conditions, identify disease outbreaks, and contribute to the broader understanding of animal biology and pathology. This historical perspective emphasizes that the foundational role necropsy has played in advancing veterinary science.[6,7]

In contemporary veterinary medicine, necropsy remains a pivotal procedure despite significant advancements in diagnostic technology. Modern necropsy techniques are complemented by sophisticated imaging modalities, molecular diagnostics, and enhanced laboratory methods, which provide a comprehensive approach to animal health assessment. The integration of these technologies with traditional necropsy practices has refined diagnostic accuracy and expanded the scope of pathological investigations. Through these advancements, veterinary pathologists can deliver more precise diagnoses, thus informing treatment strategies and preventive measures that would enhance animal welfare and health management.[2,8-10]

Looking ahead, the future of necropsy in veterinary pathology is set to evolve further with the advent of cutting-edge technologies such as artificial intelligence (AI), 3D imaging, and advanced genomic tools. These innovations have the potential to revolutionize the postmortem examination process and enable even more detailed and rapid analyses.[11,12] As veterinary pathology continues to integrate these advancements, the role of necropsy will undoubtedly expand, maintaining its critical importance in diagnosing diseases, conducting research, and shaping the future of veterinary medicine. This manuscript, therefore, seeks to explore the historical significance, current practices, and future prospects of necropsy, emphasizing its enduring relevance in the ever-evolving field of veterinary pathology.

HISTORICAL CONTEXT AND EVOLUTION

The practice of necropsy has a rich historical context that evolves significantly over centuries. Ancient civilizations, such as the Egyptians and Greeks, engaged in animal dissections for various purposes, including religious rituals and early medical education. These early dissections laid the groundwork for understanding animal anatomy and pathology. For instance, Egyptian texts such as the *Ebers Papyrus* include descriptions of veterinary practices and animal diseases, thus indicating the early recognition of the importance of postmortem examinations.[13,14]

During the medieval period, the practice of necropsy faced numerous challenges due to religious and cultural restrictions. However, the Renaissance era marked a significant turning point, characterized by a revival of scientific inquiry and anatomical studies. Prominent figures like Andreas Vesalius conducted detailed dissections of animals, which contributed to a more profound understanding of comparative anatomy, thus laying the foundation for modern veterinary pathology.[15-17]

The 19th century brought about remarkable advancements in veterinary medicine, driven by the establishment of veterinary schools and the development of systematic necropsy techniques. During this period, the works of pathologists such as Rudolf Virchow, who is often referred to as the father of modern pathology, emphasized the importance of cellular pathology. Virchow's principles emphasized the significance of understanding disease mechanisms at the cellular level, thereby enhancing the diagnostic power of necropsy.[18,19]

THE ROLE OF NECROPSY IN MODERN VETERINARY PATHOLOGY

In contemporary veterinary practice, necropsy is considered a gold standard for diagnosing unexplained deaths and diseases in animals. The procedure involves a thorough and systematic examination of the animal's body, including external inspection and internal examination of organs and tissues. The information obtained from a necropsy can confirm clinical diagnoses, reveal underlying health conditions, and identify new or emerging diseases. This is particularly crucial in the context of diseases with significant implications for animal health and public health, such as zoonotic diseases.[2,20]

Zoonotic diseases, which are diseases that can be transmitted from animals to humans, highlight the critical role of necropsy in safeguarding public health. By identifying pathogens in animals, necropsy helps in the early detection and management of disease outbreaks, thus preventing potential transmission to humans. Notable examples include the investigation of avian influenza outbreaks and the monitoring of bovine spongiform encephalopathy cases. In these scenarios, necropsy findings have been instrumental in implementing control measures and preventing widespread outbreaks.[21-23]

EDUCATIONAL AND RESEARCH CONTRIBUTIONS

Necropsy also plays a fundamental role in veterinary education and research. For veterinary students, necropsy provides hands-on experience and a practical understanding of animal anatomy, pathology, and diagnostic techniques. It serves as an essential component of the veterinary curriculum which allows students to develop the skills necessary for accurate diagnosis and effective treatment planning.[1,2]

In terms of research, necropsy provides invaluable specimens for studying disease mechanisms, evaluating treatment efficacy, and developing new diagnostic methods. Researchers can use necropsy findings to investigate the pathogenesis

of diseases, identify biomarkers for early detection, and explore potential therapeutic targets. This contributes to the advancement of veterinary science and the development of innovative solutions to animal health challenges.[24,25]

FUTURE PERSPECTIVES AND TECHNOLOGICAL INNOVATIONS

Looking to the future, necropsy in veterinary pathology is set to benefit from numerous technological innovations. Digital imaging technologies, such as computed tomography and magnetic resonance imaging, offer non-invasive methods for conducting postmortem examinations. These technologies can provide detailed anatomical images which complement traditional necropsy and enable virtual autopsies. This approach can be particularly useful in situations where a conventional necropsy is not feasible.[26-28]

Advances in molecular biology and genetics are also transforming the field of necropsy. Techniques such as polymerase chain reaction and next-generation sequencing allow for the precise detection of pathogens and genetic mutations associated with diseases. These molecular methods enhance the diagnostic accuracy of necropsy and provide deeper insights into disease etiology.[29,30]

Moreover, the integration of AI and machine learning in veterinary pathology holds great promise. AI algorithms can assist in analyzing necropsy data, identifying patterns, and detecting anomalies that may be overlooked by human observers. This can lead to more accurate diagnoses and a more efficient necropsy process.[11,31]

ETHICAL CONSIDERATIONS AND STANDARDIZATION

As the practice of necropsy continues to evolve, ethical considerations and the need for standardized protocols will become increasingly important. Ensuring the humane and respectful handling of animal remains is essential for maintaining the credibility and acceptance of necropsy in veterinary practice. In addition, the development of standardized procedures for conducting and reporting necropsies will enhance the consistency and reliability of necropsy findings, thereby improving their utility in clinical practice, public health, and research.[32]

CONCLUSION

Necropsy has a long-standing and pivotal role in veterinary pathology, and this evolved from ancient practices to a sophisticated diagnostic tool that remains essential in modern veterinary medicine. Its applications span diagnostic accuracy, public health, wildlife conservation, education, and research. As technology and scientific understanding continue to advance, the future of necropsy looks promising, with innovations set to enhance its diagnostic capabilities and efficiency. Furthermore, addressing ethical and procedural challenges will be crucial in ensuring that necropsy remains an invaluable asset in veterinary medicine, thus, contributing to the health and well-being of animals and humans alike.

Ethical approval

The Institutional Review Board approval is not required.

Declaration of patient consent

Patient's consent not required as there are no patients in this study.

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Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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