

Contents

Preface: Ruminant Diagnostics: Emerging and Classical Approaches to Individuals and Populations	xiii
--	-------------

John Dustin Loy, Jessie D. Monday, and David R. Smith

Interpretation and Analysis of Individual Diagnostic Tests and Performance	1
---	----------

Sébastien Buczinski, Simon Dufour, and Juan Carlos Arango-Sabogal

Diagnostic tests are performed daily by bovine practitioners at the individual and population level. At the individual level, they help not only for making a diagnosis, but can also serve to rule in or rule out a specific condition, monitor treatment response, establish a prognosis, or to determine infection status. Performing an individual diagnostic test is technical; however, its interpretation and contextualization requires medical and epidemiologic skills that veterinary practitioners are able to master. This article shows the added value of the context of test prescription and correct interpretation highlighting the central role of the veterinary practitioner.

Diagnostic Strategies for Ruminant Populations	21
---	-----------

Elizabeth Parker

Veterinarians may be asked to assess the presence, absence, or prevalence of a disease in an animal population or to compare the effects of management factors on disease status or production performance. The scope of diagnostic investigations in ruminant populations is often limited by the availability of time, money, and animal handling infrastructure. Selecting the correct number and type of animals to sample maximizes the benefits of the investigation, while minimizing costs. To meet the objectives of the study, the veterinarian must understand the statistical elements that need to be considered to calculate the appropriate sample size.

Submitting High-Quality Clinical Pathology Samples for Best Results	33
--	-----------

Yvonne M. Wikander

The reliability of clinical pathology laboratory results is directly related to the sample quality submitted. As such, clinicians must submit the most representative and highest quality sample possible by acquiring, handling, preparing, and shipping samples with utmost care. Cytology and blood smear slides should be evaluated for sufficient densities of intact, well-spread, nucleated cells before submission. Poorly prepared samples may delay or negate results, incurring unnecessary costs for the client and practice. Additionally, all practices should have quality assurance programs that include monitoring of equipment to minimize reporting errors. Maximizing resources is the name of the game!.

Metabolic Profiling in Ruminant Diagnostics

49

Robert J. Van Saun

A herd-based approach and interpretative perspective is necessary in using metabolic profile testing in contrast to individual animal disease diagnostics. Metabolic profile testing requires formulating a question to be answered, followed by the appropriate selection of animals for testing. A range of blood analytes and nutrients can be determined with newer biomarkers being developed. Sample collection and handling and herd-based reference criteria adjusted to time relative to parturition are critical for interpretation. The objective of this article is to review the concepts and practical applications of metabolic profile testing in ruminants.

The Role of Histopathology in Ruminant Diagnostics

73

Matthew M. Hille, Sarah J. Sillman, and Bruce W. Brodersen

Histopathology remains an important tool for ruminant disease diagnostic investigations. Some ruminant diseases require histopathology to make a definitive diagnosis. Clinical history, proper tissue sampling and handling, and proper fixation all increase the efficiency of a histopathologic examination and the likelihood of an accurate diagnosis. This article discusses some of the main organ systems of ruminants and highlights common ruminant diseases encountered by diagnosticians where histopathology is particularly important. Where applicable, correlative gross lesions, special considerations regarding tissue sampling, and histologic report interpretation are discussed.

Current and Emerging Diagnostic Approaches to Bacterial Diseases of Ruminants

93

John Dustin Loy, Michael L. Clawson, Pamela R.F. Adkins, and John R. Middleton

The diagnostic approaches and methods to detect bacterial pathogens in ruminants are discussed, with a focus on cattle. Conventional diagnostic methods using culture, isolation, and characterization are being replaced or supplemented with new methods. These include molecular diagnostics such as real-time polymerase chain reaction and whole-genome sequencing. In addition, methods such as matrix-assisted laser desorption ionization–time-of-flight mass spectrometry enable rapid identification and enhanced pathogen characterization. These emerging diagnostic tools can greatly enhance the ability to detect and characterize pathogens, but performance and interpretation vary greatly across sample and pathogen types, disease syndromes, assay performance, and other factors.

Application and Interpretation of Antimicrobial Susceptibility Testing

115

Virginia R. Fajt and Brian V. Lubbers

Antimicrobial susceptibility testing (AST) is an important component of antimicrobial stewardship. This article discusses how AST methods and breakpoints are developed, describes when AST may or may not be useful in clinical practice, and discusses how to interpret AST results from bacterial isolates from cattle, sheep, and goats. Discussion of when AST is not appropriate or when veterinarians should have low confidence in AST results is also included. Applicability of genomic testing for antimicrobial susceptibility is briefly addressed.

Diagnostics for Viral Pathogens in Veterinary Diagnostic Laboratories 129

Leyi Wang

Laboratory testing is one part of clinical diagnosis, and quick and reliable testing results provide important data to support treatment decision and develop control strategies. Clinical viral testing has been shifting from traditional virus isolation and electron microscopy to molecular polymerase chain reaction and point-of-care antigen tests. This shift in diagnostic methodology also means change from looking for infectious virions or viral particles to hunting viral antigens and genomes. With technological development, it is predicted that metagenomic sequencing will be commonly used in veterinary clinical diagnosis for unveiling the whole picture of microbes involved in diseases in the future.

Serology in Bovine Infectious Disease Diagnosis 141

Amelia R. Woolums

Serologic diagnosis is used to identify evidence of infection or vaccination by specific agents, or for population surveillance. The enzyme-linked immunosorbent assay and the serum (virus) neutralizing tests are most used for bovine serologic diagnosis. Although infectious agent-specific antibodies may include immunoglobulin M, immunoglobulin G, and immunoglobulin A, the antibody class is rarely specifically identified in diagnostic laboratory testing. When interpreting the results of serology, consider whether the antibodies are due to an agent that causes lifelong infection, transient infection with no history of vaccination, or transient infection with a history of vaccination. Paired serology is necessary to confirm recent infection in cattle with a history of vaccination.

Toxicology and Analytical Chemistry 157

Christina Wilson-Frank

Knowing how to effectively use veterinary diagnostic toxicology laboratories is key when navigating suspect toxicoses in ruminants. This begins with establishing a causal relationship between clinical signs and potential sources of exposure, followed by collecting the appropriate samples for toxicology testing. There are times in which a successful diagnosis is hindered by not obtaining a thorough case history and not knowing what specimens to collect, or how much specimen to submit, for toxicology testing. This article is intended to offer some guidance with respect to the effective use of veterinary toxicology/analytical chemistry laboratories when navigating suspect toxicology cases in ruminants.

Next-Generation Diagnostics for Pathogens 165

Rebecca P. Wilkes

Next-generation sequencing (NGS) was initially developed to aid sequencing of the human genome. This molecular method is cost effective for sequencing and characterizing genomes, not only those of humans or animals but also those of bacteria and other pathogens. However, rather than sequencing a single organism, a targeted NGS method can be used to specifically amplify pathogens of interest in a clinical sample for detection and characterization by sequencing. Targeted NGS is an ideal

method for ruminant syndromic testing due to its ability to detect a variety of pathogens in a sample with a single test.

Future Directions for Ruminant Diagnostics

175

John Dustin Loy, Jessie D. Monday, and David R. Smith

Diagnostic advances such as next-generation sequencing, highly multiplexed real-time PCR tests, and MALDI-TOF mass spectrometry have provided a tremendous increase in the amount of diagnostic information to clinicians. However, interpretation and application of these results to both individual and herd-level diagnostics still require the necessary skills in critical thinking and diagnostic interpretation to maximize benefit. This article provides a summary of advancements in diagnostic medicine and interpretation, as well as identifies gaps in knowledge that can be targeted to continue to build on best practices and application of diagnostic tools to improve ruminant health.