

Digital imaging powers a new age of cytology



Abstract

- Cytology is an important tool in the identification and characterization of disease in veterinary patients.
- Digital scanning of microscope slides and the subsequent interpretation by a clinical pathologist are comparable to traditional methods using a light microscope.¹⁻³
- IDEXX has adopted digital scanning and remote reading of cytology cases by their network of clinical pathologists.
- Veterinarians can also scan and submit slides via the in-clinic IDEXX Digital Cytology™ instrument and receive an interpretation from an IDEXX clinical pathologist in less than 2 hours.

Introduction

Cytology is the microscopic examination of cells collected from tissue, organs, or fluids. The specimen is obtained from the patient, transferred to a microscope slide, stained, and then evaluated under a microscope. It is a process commonly used by veterinary professionals to identify and characterize disease in their patients. Often it is utilized in situations where serious conditions are suspected, such as inflammation, infection, and cancer. Some of the main advantages of cytology are that specimens can be acquired via minimally invasive techniques, sedation and/or general anesthesia is rarely needed, and there is minimal specimen preparation and processing. Furthermore, with cytology, the time to results is faster and generally at an affordable cost to the pet owner. Cytologic findings typically have a close correlation with histologic findings.

Board-certified veterinary clinical pathologists provide expert evaluation of cytologic specimens. In most cases, the pathologist provides a full interpretation with 1-2 high-quality cytology slides per site. The use of digital cytology at the reference lab enables access to a global network of board-certified, veterinary clinical pathologists. With in-clinic digital cytology, access to an expert veterinary clinical pathologist is no longer dependent upon submission of samples to a reference laboratory, and veterinarians can receive results in two hours or less.

It is important to recognize there are limitations to cytology. To interpret the specimen, cells are examined outside of their normal architecture, which may prevent full appreciation or characterization of a disease process. One should always remember that the diagnostic yield of cytologic evaluation is highly dependent on the quality of the specimen obtained, the preparation of the slides, and the clinical information provided by the submitting veterinarian. Lack of cells on the slide, thick preparation, or ruptured cells may result in incomplete interpretation. Lastly, cytology is never curative, whereas excisional biopsy specimens submitted for evaluation may potentially remove the diseased tissue completely.

Cytology slides have been traditionally prepared for examination under a light microscope, requiring both the pathologist and slide to be in the same physical location. In recent years, technological advancements in digital imaging have revolutionized how

pathologists view slides. Glass slides can now be scanned to produce a high-quality digital image, which eliminates the need for the pathologist to be in possession of the physical slide and microscope, enabling access to a global network of pathologists.

Digital cytology basics

Digital cytology relies on magnification and resolution of digital images. Magnification refers to how big something appears. For example, if an object or specimen measures 1 cm x 1 cm and the image you see after magnification is 4 cm x 4 cm, then it has been magnified four times.

Resolution is how much detail you can see and is expressed in megapixels per square inch (or commonly just "megapixels"). The more megapixels per square inch, the more detail one can see in an image. Magnification is only useful if increasing the size of an image allows you to see more detail (see figures 1A and 1B). Within a digital cytology scanner, the camera capturing images through the objective can do so at a resolution far greater than the human eye. Thus, when those images are then enlarged on a computer monitor, they have been magnified without losing any fine detail.

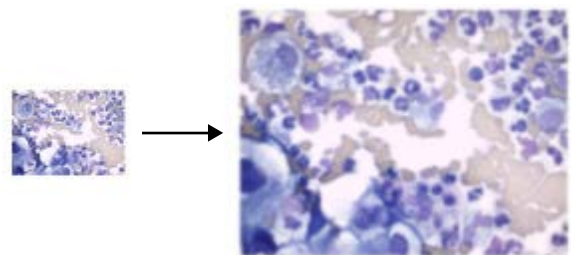


Figure 1A. Magnification of a lower-resolution image.

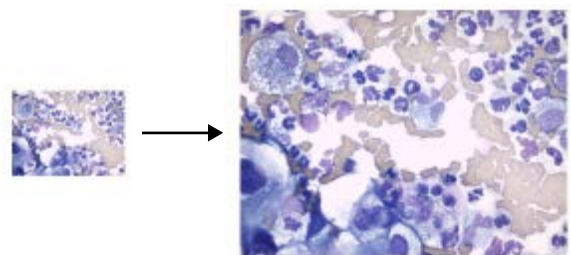


Figure 1B. Magnification of higher-resolution image.

Digital cytology in veterinary clinical pathology

The discipline of pathology can trace its roots back to 4th century BC to the Greek physician Hippocrates. With the invention of the light microscope in the 17th century, scientists were for the first time able to accelerate the study of biology and disease at the cellular level. While technological advancements have been made to light microscopes since the time of Rudolf Virchow (1821–1902; considered the father of microscopic pathology), the principles of light microscopy still rely upon using a condenser lens system to focus light on a specimen and an objective lens to provide magnification.



Veterinary clinical pathologists receive intensive training with the light microscope as their main investigative tool. Their interpretation of a cytology specimen is dependent on close examination of fine cellular detail and other aspects of the specimen, such as the presence of infectious agents. As a new technology like digital cytology emerges, careful consideration should be given to whether it affects the pathologist's interpretation because their expertise has been built through evaluating thousands of slides under a light microscope. To validate digital cytology as a noninferior modality to glass slides under a light microscope, several comparison studies have been published demonstrating high agreement in an individual pathologist's interpretation of cases read by glass versus digital images.¹⁻³ As a result, digital cytology is becoming more widely adopted in clinical pathology training programs and diagnostic laboratories.

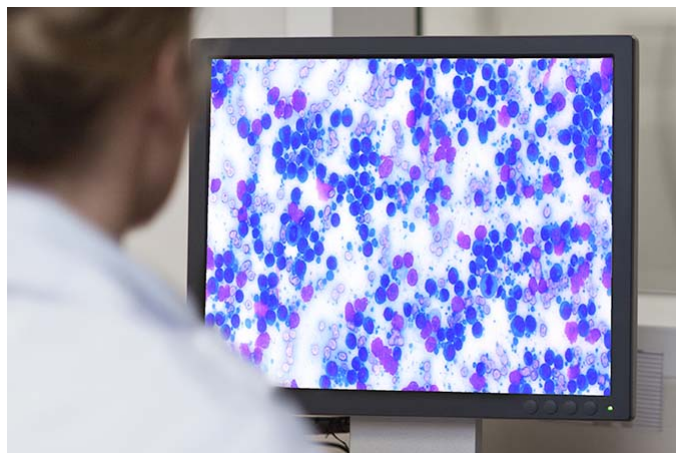
Digital cytology at IDEXX

IDEXX Reference Laboratories: In-lab digital scanning and remote reading

Digital cytology slide scanning involves creating a digital, magnified image of a glass slide, which can then be evaluated by the clinical pathologist. Within a digital slide scanner, an objective lens in combination with a digital camera travels the surface of the slide, capturing a high-resolution image.

In 2019, IDEXX began the deployment of digital cytology slide scanners throughout their reference laboratory network. Now, when veterinarians submit glass slides for cytologic interpretation, a high-throughput digital scanner produces a digital image of the slide, which can then be distributed to an IDEXX clinical pathologist to read the case. Since pathologists are using digital images, they no longer need to be physically present at the laboratory to read the case. This allows IDEXX to

offer and support a flexible clinical pathology workforce as well as avoid service disruptions, such as those encountered with COVID-19 isolation and quarantine protocols.



The digital scanning and remote reading of cytology cases has several benefits. Once the slides submitted to an IDEXX reference laboratory are stained and processed through the digital scanner, these cases are more efficiently distributed throughout the network of clinical pathologists. Pathologists can then view, manipulate, and evaluate images in ways that were previously impossible with a light microscope. In addition, with digital slide scanning, the images can be shared easily among clinical pathologists for case collaboration and continuing education.

A small volume of slides sent to the ref lab are still read on glass slides. For example, wet mounts slides and dirty preparations (e.g., ear swabs and fecal smears) cannot be scanned due to risk of contamination of the internal optics. A small percentage of slides sent to the reference laboratory are not read digitally due to blurriness, a missed area of interest, slide preparations that are too thick, or damaged slides. Although these scenarios represent a small percentage of the cases submitted to the reference laboratory, IDEXX has established workflows and protocols to redirect these cases for reading via traditional light microscopy.

IDEXX Digital Cytology instrument: In-clinic digital scanning and remote reading

While the scanning process above describes the benefits when a veterinarian submits glass slides to a reference laboratory, little gain is made in time to results because the microscope slides typically must be transported to the laboratory facility via courier. In January 2020, IDEXX introduced an in-clinic digital cytology scanner to their North American customers. This allows the veterinarian to scan and submit their cytology slides to IDEXX Reference Laboratories via the IDEXX Digital Cytology™ instrument. The instrument uses the same optics that are used in the scanners at IDEXX Reference Laboratories. These cases are then electronically submitted to the global network of IDEXX clinical pathologists. By removing the need for a courier, pathologists can provide an interpretation in 2 hours or less. Pathologists can access the patient's diagnostic profile through VetConnect® PLUS, providing a comprehensive assessment. This service is available 24 hours a day, 7 days a week, 365 days a year.

Receiving a cytology interpretation from a board-certified clinical pathologist in less than 2 hours allows the attending veterinarian to make more informed and earlier decisions on case management. This is particularly important in cases with medical urgency (e.g., septic abdomen and lymphoma). Furthermore, earlier access to information can help alleviate anxiety felt by the pet owner in situations where cytology is an important component of diagnosing serious medical conditions, such as cancer. As with all pathology submissions to IDEXX, every report includes the pathologist's name, email, and phone number to make themselves available to the submitting veterinarian for follow-up consultation.

Ordering information

Test codes and submission requirements for IDEXX Reference Laboratories are available at vetconnectplus.com. Submit up to two slides per site for cytology submissions. Use the appropriate test code based on the number of sites and the desired turnaround time. Reference laboratory fees are determined by the number of sites, lesions/masses, or types of specimens submitted.

For more information about receiving in-clinic whole-slide cytology interpretations in 2 hours or less, 24/7/365, via the IDEXX Digital Cytology instrument, visit idexx.com/digitalcyto.

Customer support services

IDEXX supports your practice with on-site field support, customer support, and medical consulting services, including diagnostic support veterinarians and board-certified veterinary specialists.

1-888-433-9987

References

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