Introduction of Whole Slide Imaging in Pathology at Oklahoma University (OU) Medical Center

Whole Slide digital Imaging (WSI) is a new technology that is beginning to be implemented in pathology practices. The Pathology Department at OU Medicine obtained new WSI technology over a year ago. Lewis A. Hassell, MD, a pathologist at OU Physicians, is leading the effort to adopt WSI in his practice. Dr. Hassell explained that they acquired an Aperio 5-slide scanner and Spectrum software to test in their environment. The goal was to introduce the idea of digital pathology to their group to gain knowledge and experience. They wanted a scanner on site to experiment with using WSI for their cases and to evaluate the next step in clinical use. Once this new technology was available on site, various uses of WSI emerged.

Whole slide digital imaging uses computerized technology to scan and convert pathology specimen glass slides into digital images which are then accessible for viewing using a computer monitor and viewing software. This is known as virtual microscopy because the images are viewed without the use of a microscope or slides. The digital slides (images) are maintained in an information management system that allows for archival and intelligent retrieval. Computerized image analysis tools can be used with digital slides to perform objective quantification measures for special stains and tissue analysis. Digital pathology is an image-based information environment that supports the management of information generated from digital slides for use in education, diagnostics, publications and research.

The primary use of WSI at OU Medicine, at this time, is for presenting pathology cases at multidisciplinary tumor boards and for teaching residents and medical students. At tumor board conferences, the radiologists present all of their digital images and the pathologists used to struggle with getting good tissue images for their presentations or used no tissue images at all. Today, WSI allows for multiple tissue images to be presented as the pathologist demonstrates various areas of interest and disease on multiple slides with the ability to interactively demonstrate different magnifications and present special tissue stains. The use of color digital images in presenting pathology findings has elevated the professional level of the pathology presentations and now, pathology is viewed on an equal or higher level than the radiology imaging. The response from other doctors has been very positive and some have asked “Can we get that?”

OU Medicine located in Oklahoma City, is the partnership between OU Medical Center (OUMC), the Children’s Hospital, OU Physicians, and the University of Oklahoma College of Medicine. Their mission is leading health care and their vision is to be the premiere enterprise for advancing health care, medical education and research in their region. OU Physicians are committed to patient care that is enhanced by education and research and the OU Medical Center, including The Children's Hospital, is Oklahoma's largest and most comprehensive hospital. The multispecialty pathology group has 21 full time pathologists plus a residency
training program in anatomical and clinical pathology. All of the pathologists serve on the faculty at the OU Medical School.

The implementation of WSI in pathology at OUMC was described by Dr. Hassall as fairly smooth. The legacy pathology system captures bar codes and specimen numbers and transmits this information into the WSI system. The major issue is that the WSI system does not link information back to the laboratory information system. This function needs to be improved upon so that the sharing of work flow information is “bidirectional”. The images are stored locally on an image server in pathology. Due to the very large size of the WSI files, business rules have been developed for storage requirements by the technology team at OU Medicine. A future need will be an enterprise wide picture archiving and communications system (PACS) that can manage and store pathology images in a way that is similar to the archive systems used for radiology digital images. An integrated PACS that would store radiology and pathology images and reports together for individual patients would be ideal.

Pathology residents at OUMC are introduced to WSI as part of their training. The low power images are clear and crisp and they are great for teaching. Those who have been exposed to digital images in medical school and are technologically savvy do just fine. Other residents that are less comfortable with computers are still a little resistant to this new technology. Most of the residents have difficulties with the cytology slides as these currently lack depth of focus unless special scanning techniques are used. A new tool also needs to be developed for navigating the pathology images. The current interface using a mouse and clicker is a little clunky and needs improvement for optimal functionality. Those who are accessing slides over the internet at home experience issues with network speeds due to the large size of the digital pathology images. A digital image working group has been started at OU to explore new applications for WSI. One idea is to use senior residents to sign out after hours frozen section cases in real time and then the slides can be scanned and the images sent over the internet for formal review by an experienced pathologist off site.

Currently, the pathology slides are usually scanned by support personnel (the scanner is physically located near their desks), but the scanner is also available for use by pathologists or medical school personnel to use once they are trained. Since the pathology department anticipates using this technology in the future for frozen section backup of on call personnel, all pathology residents and histology personnel will be trained to use the scanner. The scanning time depends on the magnification settings used, the area of the slide scanned (all cuts versus small area only). At 20x (standard scanning magnification) a routine H&E stained slide can be scanned in about 2 minutes, but at 40x, which is used for cytology samples or blood smears, the scanning time might be as long as 10 minutes. An average of 50 slides are scanned per day, with varying volume day to day. Only about 25% of the scanner’s capacity is being used right now.

Dr. Hassell stated that one of the most positive aspects of WSI is the ability for multiple pathologists to easily view the same slide from different locations, either simultaneously or asynchronously. There is interaction and collaboration that occurs when the same slide is viewed as a group around a multi-head microscope that could potentially diminish if residents
only view WSI individually. But on the other hand with the expanded ability of sharing of slides over the internet, this educational collaboration and interaction can be extended to groups of pathologists viewing the slides together in real time at various locations. Another positive feature of WSI is the ability to measure a digital image quickly and easily using the digital ruler. You can accurately and quickly determine the “depth of invasion” or “distance from margin.” The use of more advanced image analysis tools allow precise measurements of the cell size and nuclear material.

The return on investment of WSI technology cannot be measured in just dollars. As an academic institution, it is important to be using and teaching new tools in diagnostic pathology. The ability to integrate the gross photography images with the WSI is great. The WSI eliminates the need for each pathologist to have digital cameras on each microscope and to routinely take the field of view images. Sharing images electronically may also decrease the transportation costs associated with shipping of glass slides. Patients referred to OUMC from other hospitals often have pathology slides that are shipped to the OUMC pathology department for consultation and review. The ability to accept digital slides in consultation eliminates this physical transportation cost. When glass slides are shipped, using WSI to obtain digital images, the glass slides can be returned and the image files saved on site. This allows OUMC pathologists to have the patient’s clinical information available for future reference if and when it is needed.

Although the primary use of WSI at this time is for tumor board conferences and for teaching, there is a clear value in expanding the use of WSI in the future. This is just the first step by the pathology department at OU Medicine in implementation of this new technology over many years.

*Dr. Lewis Hassell is board certified in pathology and cytopathology. His primary areas of interest are in cytopathology; gynecologic pathology; surgical pathology. Dr. Hassell is a member of the College of American Pathologists Digital Imaging Task Force.*