

Are We Throwing Histology Out With the Microscope? A Look at Histology From the Physician's Perspective

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A trend in medical schools across the United States is the refurbishing of histology laboratories with digital microscopy systems. Although such systems may reduce curricular time, they do not teach basic microscope skills, and students who learn solely with these systems may be less prepared for their practices or specialties, particularly in rural areas that may not be equipped with digital microscope technology. At the West Virginia School of Osteopathic Medicine (WVSOM), students are trained to practice in a wide variety of environments, especially rural areas. A research survey was conducted to gather information for evidence-based decisions about histology education at WVSOM. The survey asked a range of questions concerning histology knowledge, tissue preparation, and microscopy. Responses did not differ significantly between physicians in urban versus rural practices. Ninety percent of physicians do not utilize digitized images, and only 50% have microscopes readily available. Regardless of the technology available, 90% feel that students must have microscope training and 88% of physicians feel that histology is important to the medical curriculum and use their histology knowledge often (weekly or daily) (66%). These results demonstrate that histology education should move toward a blending of traditional microscope and glass slides with computer-based instructional technologies. *Anat Sci Educ* 2:205–209, 2009. © 2009 American Association of Anatomists.

Key words: histology education; medical education; microscopes; virtual microscopy; rural clinical practice; urban clinical practice; histology survey; osteopathic physicians

INTRODUCTION

Over the past ten years, there has been a dramatic increase in the use of computer-aided instruction in the histology laboratory (Cotter, 2001; Blake et al., 2003; Bloodgood and Ogilvie, 2006; McBride and Prayson, 2008; Pinder et al., 2008). Surprisingly, the large increase in the number of schools using computer-aided instruction has not been accompanied by an equivalent decrease in the number of schools that utilize microscopes and glass slides (Bloodgood and Ogilvie, 2006). At many universities, the trend has been toward a blending of the new computer-based instructional technologies with

the long-standing use of microscopes and glass slides (Bloodgood and Ogilvie, 2006).

In 1998, the University of South Carolina's School of Medicine conducted a survey of medical school microanatomy/histology courses (Bloodgood, 2005). Survey results demonstrated that 11 years ago microscopes were used in almost all of the histology courses whose directors responded and that microscopy encouraged problem solving and self-learning. In 2001, the same group of researchers took another look at microscopy in medical schools regarding the overall use of microscopes. Results to the following questions were as follows: Have you phased out microscopes? yes: 9% ($n = 4$), no: 91% ($n = 42$). Do you plan to phase out microscopes in the near future? yes: 16% ($n = 7$), no: 84% ($n = 36$). Do you feel the microscopes will continue to play an important role in your course? yes: 85% ($n = 41$), no: 15% ($n = 7$) (Bloodgood, 2005). These inquiries gathered 8 years ago are still relevant questions to ask today, but now we must broaden our audience to include the practicing physicians who will be working with our new medical graduates.

In September 2006, *The Anatomical Record* featured an article by Bloodgood and Ogilvie (2006) discussing trends in

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histology laboratory teaching in 82 medical schools (including three schools outside United States). Similar to previous surveys by Drake et al. (2002) and Gartner (2003), the instrument used by Bloodgood and Ogilvie (2006) also identified steady decline in hours of histology laboratory instruction that each student received in the medical curriculum. An average number of hours of laboratory instruction reported by these authors was 37.4 (with range 1–75 hours). This survey also reported a reduced number of faculty effort devoted to histology laboratory instruction and the percent usage of various computer-based technologies including virtual slides and virtual microscopy during the course. Along with the issues related to contact hours devoted for histology instruction, authors also addressed concerns regarding how laboratory material should be distributed. Although Bloodgood and Ogilvie (2006) study addressed many pertinent questions regarding curricular modification and provided useful data, it did not address the physician's perspective of histology requirements for practice in today's medical field.

A number of medical school histology course directors are exploring the question of how to most effectively make use of virtual microscopy (Scoville and Buskirk, 2007). In 2007, these authors compared the efficacy of teaching traditional microscopy versus virtual microscopy and examination using the two methods (Scoville and Buskirk, 2007). They found no significant differences in test scores when they examined effects by learning group or by testing group. The testing outcome did not vary with the tools utilized to prepare for the examinations nor did the students present a strong unified response for one or the other microscopy styles. It is important to note that the authors reported students were unable to identify tissue on slides with a microscope after being taught entirely with the virtual format (Scoville and Buskirk, 2007). If both virtual microscopy and traditional microscopy provide similar outcomes, we need to make sure that we do not ignore the fundamental goal of medical school: to put forth graduates who will be successful in their chosen specialty regardless of tools at hand.

This having been said, the author of this study reached beyond academic walls and asked physicians to describe the needs and common practices of their rural and urban clinics regarding biopsy preparation, microscope use, and diagnosis. An important aspect of this survey was to ascertain the degrees to which physicians use histology and pathology in their varied practices, from general practice doctors to specialists. The author thought it worthy to poll physicians practicing in both rural and urban settings across the country on what skills were important to maintain in today's histology curriculum. Their answers provide valuable insight to direct curricular change and train students for their years in residency as well as their practice.

This study aimed to gather physician perspectives on how best to incorporate microscopes and virtual microscopy in the histology laboratory. Through a series of questions focusing on practice location, time in practice, tools utilized for tissue preparation and diagnosis, the author learned about histology knowledge required of osteopathic medical school graduates in a variety of demographics. Analysis indicated that there was no difference statistically between answers provided by doctors practicing in rural and those in urban clinics. It was hypothesized that physicians practicing in the field for six or more years would respond that microscopy is more valuable compared with responses gathered from physicians practicing for five years or less. This dis-

crepancy was hypothesized because doctors who were trained on microscopes might place an understanding of microscopy higher than those who had limited laboratory exposure or used digital technology. It was determined that there was no difference statistically between answers offered by physicians practicing less than six years or those with greater than six years experience. Moreover, responses confirmed that histology is important to practicing physicians and that medical laboratory education in histology should blend traditional microscopes and glass slides with computer-based instructional technologies.

METHODS AND DEMOGRAPHICS

This research survey was designed to provide the author with the opportunity to look at national hospitals, clinics and residency programs, and the current physician's perspective on histology and microscopy skills. Data gathering began with a pilot research survey on issues influencing histology instruction that was distributed to participants of the West Virginia School of Osteopathic Medicine (WVSOM) Mid-Winter Continuing Medical Education (CME) in February 2007 (WVSOM-IRB approved; RP13107). The survey was then extended to osteopathic physicians nationally to gather additional data regarding current histology/pathology procedures and the tools utilized in rural (25 miles from an urban center or a population of $\leq 2,500$ residents) and urban practices. Out of the 1,750 distributed surveys, 214 completed forms were received. The return performance was comparable with the number of responses the alumni center received for their personal questionnaire sent concurrently. The author received responses from physicians practicing in 30 different states, with 39% of the completed surveys arriving from the state of West Virginia. Forty-three percent ($n = 84$) of physician responses identified their practice as rural (in population of $\leq 2,500$ residents or 25 miles from an urban center), whereas 57% ($n = 111$) indicated urban for their clinic location. Physician responses represent 23 different medical specialties. The top two areas of expertise indicated were family practice (47%, $n = 102$) and internal medicine (9%, $n = 20$). The minimum number of years in practice was 0 and the maximum was 30 years with a mean of 11.91 years (standard deviation of 8.28). The Charleston Area Medical Center (CAMC) Health Education and Research Institute assisted with the statistical analyses (Chi-Square and Fisher's Exact test).

RESULTS

Answers compiled from the completed surveys were analyzed for statistically significant differences between rural versus urban practices. It was hypothesized that there would be significant dissimilarities between preferences of physicians who practiced in remote locations versus those practicing in larger hospitals and more populated areas. Table 1 demonstrates the overall response of the physicians that have access to a microscope in their practice. Fifty-seven percent ($n = 118$) of all physicians responded that they have access to a microscope, whereas 43% ($n = 89$) did not have this equipment on hand. A Chi-Square test determined that there was no significant difference between doctors practicing in rural or urban clinics ($P = 0.7904$, data not shown). Table 1 also reveals that 90% ($n = 186$) of queried physicians believed that it was impor-

Table 1.General Responses Tabulated From Physician Surveys ($n = 214$)

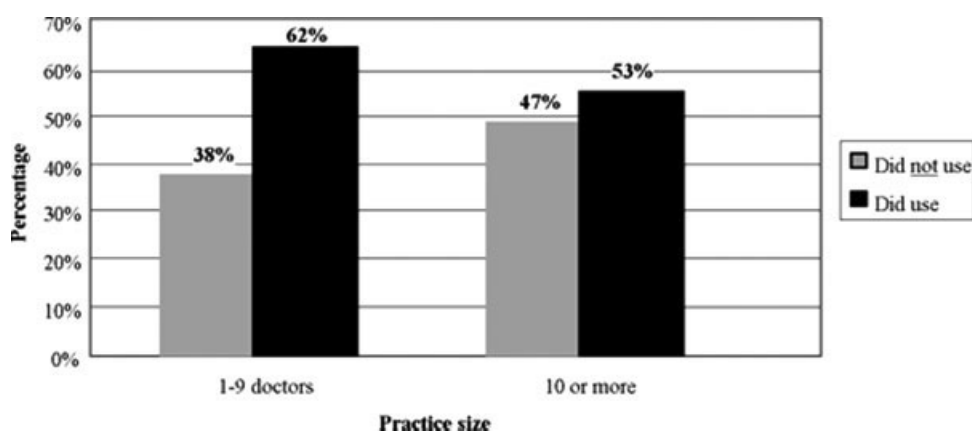
Question	Yes	No
Is a microscope available for use in your practice?	57%	43%
Do physicians believe that it is important to have microscope skills and a general understanding of microscopy for practice?	90%	10%
Does knowing histology aid in your ability to effectively translate biopsy reports?	88%	12%

tant to have microscope skills and a general understanding of microscopy, whereas 10% ($n = 21$) did not. A Chi-Square test determined that there was no statistical difference between urban and rural practicing doctors regarding the importance of having microscope skills for diagnosis ($P = 0.4056$, data not shown).

Despite variations in geographic location and the size of the physician's clinic staff, histology knowledge was perceived to be important when translating biopsy reports; 88% ($n = 185$) answered yes and 12% ($n = 25$) said no. A Chi-Square test determined that there was no statistical difference between urban and rural practicing doctors regarding the importance of histology as an aid in pathology ($P = 0.2394$, data not shown). A Fisher's Exact test determined that practice size did not influence physician perspectives of the significance of histology education in translating biopsy reports ($P = 0.5686$, data not shown). When asked further how biopsies were presented to practicing physicians for review, surveys illustrated discrepancies in slide preparation for examination. Only 3% ($n = 2$) of physicians indicating a

rural practice received digitized slides for viewing compared with 16% ($n = 16$) of doctors practicing in towns with <2,500 residents. There was a significant increase in the use of digitized histopathology in urban compared with rural practices ($P = 0.0036$; data not shown). This prompted further analysis to determine whether or not the size of the practice had any influence on the use of microscopes during diagnosis. Sixty-two percent ($n = 57$) of clinics employing one to nine doctors responded that they use a microscope for diagnosis, whereas 38% ($n = 35$) did not. Only 53% ($n = 61$) of physicians in larger hospitals (comprised of 10 or more physicians) used microscopes and glass slide specimens for diagnosis compared with the 47% ($n = 54$) that did not access this equipment (Fig. 1). Chi-Square test revealed that there was no significant difference between small clinics and larger hospitals regarding the actual use of microscopes for diagnosis ($P = 0.1981$). An additional Chi-Square test revealed that urban and rural practices do not vary statistically with microscope utilization ($P = 0.7481$, data not shown).

The demographics collected prompted further analysis to determine if the numbers of years in practice had an affect on the responses regarding microscope proficiency. This discrepancy was hypothesized because doctors who were trained on microscopes might favor microscopy more than those who had limited microscope exposure. The responses to the following survey questions were examined based on years in practice: (1) is it important for future doctors to have basic microscope skills? (2) Do you feel that knowing histology aids in your ability to effectively translate findings to the patient? Physicians practicing 5 years or less responded positively to each question 95% ($n = 62$) and 86% ($n = 56$), respectively. Physicians practicing 6 years or more also responded positively to each question 87% ($n = 120$) and 89% ($n = 125$), respectively. Chi-Square analysis determined that there was no statistical significance in the importance of obtaining microscope skills ($P = 0.0658$) or a physician's need for histology knowledge ($P = 0.6098$) based on years in practice (data not shown).

**Figure 1.**

Does practice size influence whether or not microscopes are used during diagnosis? Sixty-two percent of clinics employing one to nine doctors responded that they use a microscope for diagnosis, whereas 38% did not. Only 53% of physicians in larger hospitals (comprised of 10 or more physicians) used microscopes and glass slide specimens for diagnosis compared with the 47% that did not access this equipment. Chi-Square test revealed that there was no significant difference between small clinics and larger hospitals regarding the actual use of microscopes for diagnosis ($P = 0.1981$). An additional Chi-Square test revealed that urban and rural practices do not vary statistically with microscope utilization ($P = 0.7481$; data not shown).

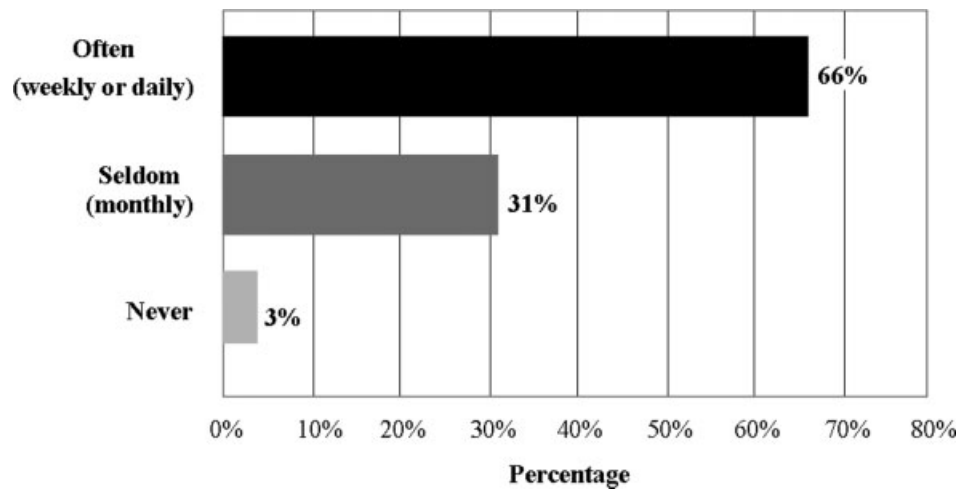


Figure 2.

Regardless of clinic location or years in practice, an understanding of histology is essential to practicing osteopathic physicians. The Fisher's Exact test determined that there was no statistical difference between urban and rural practicing doctors regarding how often they utilize their histology knowledge as a physician ($P = 0.3226$). Physicians practicing five years or less responded positively (weekly or daily) to this question at 62%. Physicians practicing six years or more responded positively (weekly or daily) to this question at 68%. Answers provided by physicians practicing less than five years and those further along in their careers showed no significant difference concerning how often they utilize their histology knowledge as a physician ($P = 0.3767$; data not shown).

Although the survey results supported histology as an essential medical discipline, physicians were asked for further detail on how often they actually called upon their basic histology and anatomical pathology knowledge: never, seldom, weekly, or daily. Responses were tallied as never, seldom, or often (weekly or daily) and compared by rural or urban practice location. Responses to the question: "regardless of clinic location, an understanding of histology is essential to practicing osteopathic physicians" shown in Figure 2 were as follows: never: 3% ($n = 7$), seldom: 31% ($n = 65$), and often: 66% ($n = 139$). The Fisher's Exact test determined that there was no statistical difference between rural and urban practicing doctors in how often they utilized their histology knowledge ($P = 0.3226$, data not shown). Responses to the same question were then tallied regarding years in practice. Sixty-two percent ($n = 41$) of physicians practicing 5 years or less responded positively (weekly or daily) to this question, whereas only 36% ($n = 24$) said seldom or never (2%, $n = 1$). Physicians practicing 6 years or more also responded positively (weekly or daily) to this question at 68% ($n = 96$). Only 28% ($n = 39$) of experienced physicians responded that they seldom rely on their histology and anatomical pathology knowledge, whereas 4% ($n = 6$) never applied these skills professionally. The Fisher's Exact test determined that answers provided by physicians practicing less than 5 years and those further along in their careers showed no significant difference concerning how often they utilize their histology knowledge as a physician ($P = 0.3767$; data not shown).

On the survey, there was space provided for comments regarding the use of histology in the current medical curriculum. The following examples represent the range of the responses received:

- "To obtain basic knowledge that enables physician to understand and properly interpret results."
- "To understand path/histology and with a pathologists [sic] confirmation make a definitive diagnosis for your patient and together decide on a treatment."

- "You never know where you are going to be. It is important to gather as much knowledge as possible."
- "It is a valued part of any medical school basic science curriculum. It is important in the context of medical education."
- "Understand meaning/significance of diagnostic terms. Basic knowledge of microscopic histology."
- "Not sure. I thought it was a great class when I had it but I honestly do not use it much. However, I feel it is very important to understand in any field of practice in order to understand and be able to show empathy toward your patient."
- "Basic preparation and identification. Knowledge of report diagnoses understanding to communicate results to patient."

This study has demonstrated that physicians in both rural and urban clinics need to acquire both microscope skills and a solid background in histology to successfully interpret pathology and make appropriate diagnoses.

DISCUSSION

Histology is a valuable course in medical school curricula. It is essential that we recognize histology as a course that not only teaches students the necessary vocabulary to interact effectively with patients and peers but also the still-needed microscope skills. Results from this survey highlight the need for both rural and urban physicians to have basic tissue identification skills as well as a general understanding of the microscope.

Without a doubt, virtual microscopy technology has proven to be a positive addition to the world of microscopic anatomy (Harris et al, 2001; Heidger et al., 2002; Krippendorf and Lough, 2005; Lei et al., 2005). Virtual microscopy seems to eliminate the skill barrier for students overwhelmed with the material and interpretation of specimens using a microscope (Kumar et al., 2006). For teaching large groups

of first-year students, the use of virtual microscopy also solved problems associated with slide variability (Kumar et al., 2006). Its adoption also helped avoid earlier student complaints that particular slides in their individual glass slide collections were not as good as those of a fellow student (Blake et al., 2003). It is essential that we also realize that virtual microscopy is not the total answer to a perfect, streamlined histology course. Students still need to acquire microscope skills, learn to read a tissue specimen (not simply memorize an image), and discover that tissue samples are subject to anatomical variation.

Universities and medical schools that have introduced this technology to their students have found, not surprisingly, that students prefer the digital approach and believe that it should be expanded to completely eliminate the need for microscopes in histology (Harris et al., 2001; Blake et al., 2003; Krippendorf and Lough, 2005). However, findings in these studies are not necessarily shared by practicing physicians. Therefore, although some students may never encounter a microscope, it is imperative that their medical school training prepare them to tackle any discipline in their rotations and residencies by giving them the skills for success early on and not limiting their choices by abandoning a useful laboratory skill. It is necessary that any modifications to histology coursework be tailored to meet not only current curricular needs but needs essential in clinical practice after graduation (Burns, 2006; McBride and Prayson, 2008).

It is important to recall that 122 of the 214 physicians who responded were generalists/internists. It is possible that the results supporting traditional microscope skills are purely influenced by the daily roles of these particular specialties. Although this is something to consider, one must note that the remaining 92 surveys representing 21 subspecialties such as surgery, pathology, emergency care, and neurology did not negatively affect support for microscope skills (data not shown). Perhaps then histology education should progress as a hybridization of traditional microscope technology and glass slide specimens along side the newer computer-based instructional technologies (virtual microscopy systems), so we continue to train our future doctors for successful residencies and careers in whatever medical specialty they pursue and wherever that choice might take them.

Regardless of the motivation behind curricular change and implementation, educators need to remember the importance of retaining essential skills to read tissue specimens with microscopes as well as through computer applications. Based on the outcomes of this research survey, WVSOM has decided to supplement the current traditional microscope laboratory with a virtual microscopy system that can be accessed via laptop at any time by all preclinical students. The current course description offers laboratory exercises in both media, so students may take advantage of both educational formats. It will be important to continue to record the pros and cons of both formats, and combinations thereof, through student feedback. Currently, the author has gathered feedback from students who were taught only with traditional microscopes and glass slides (Class of 2010), those that had virtual microscopy available to them outside of their mandatory glass slide laboratories (Class of 2011) and students who learned via digital technology for the first half of the class and continued with microscopes and slide boxes for the remainder of the course (Class of 2012). Future assessments will be important in determining the perceived benefits each format brings to histology education.

Current medical students often question the relevance of the information they are presented, most notably the acquisition of microscope skills and histology knowledge. Future studies will involve an in-depth review of the allopathic profession and a comparison between survey results of the two physician tracks. Based on the significant difference in responses from rural and urban physicians when asked "Are biopsy slides digitized for you to examine?" it will be important to track national trends of digital microscopy usage in the medical profession and the influence geographic location has on its implementation.

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NOTES ON CONTRIBUTOR

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