Radiologic-pathologic Correlation—An Advanced Fourth-year Elective: How We Do It

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Traditionally, the radiology elective has been designed to teach medical students the fundamentals of radiologic interpretation. When questioned, many students state that they want to take a radiology elective so they can "interpret images." For the students on radiology, rotation/elective education was often passive, consisting of didactic conferences and observational shadowing of radiologists as they interpreted images. Students had only a superficial appreciation of how radiologists interacted with clinical services, multidisciplinary teams, and pathology. There was very little emphasis on imaging appropriateness or the most efficient and effective imaging for various clinical problems. With the expansion of numerous imaging modalities and the emphasis on patient-centered care, including imaging safety and dose reduction, it is important to change the focus of radiology education from interpretation to the optimal integration of imaging into clinical medicine.

Radiology-pathology (rad path) electives were created at Allegheny General Hospital and the Medical University of South Carolina as a new option to provide a high-quality advanced elective for fourth-year medical students. These electives enable students to correlate radiologic images with gross and microscopic pathology specimens, thus increasing their knowledge and understanding of both. The rad path elective combines aspects of surgery, radiology, and pathology and requires students to be active learners. The implementation of this elective is an exciting work in progress that has been evolving over the past 2 and 4 years at Medical University of South Carolina and Allegheny General Hospital, respectively. We will discuss the historical basis for the elective, the advantages and challenges of having such an integrated course, and some different strategies for creating a rad path elective.

Key Words: Radiology-pathology correlation; medical student education; radiology clerkship.

INTRODUCTION

Radiology and pathology can be introduced into the radiology curriculum in a variety of ways. A study by Poot et al found that 25% of schools require radiology as a stand-alone required clerkship, while 6% of schools require pathology (1). A recent trend in radiology medical student education is to integrate radiology throughout the curriculum. Students who do not have a required radiology clerkship may get radiology education incorporated into preclinical coursework and the required third-year clerkships taught by radiologists and/or clinicians. A study by Straus et al found that the biggest change that radiology chairs and medical student deans would like to see in radiology medical student education was to increase the vertical curricular integration (2).

How are we doing with this vertical curricular integration? While it is too early to do an outcomes study, an unpublished survey by Hartman et al attempted, in part, to answer this question by asking fourth-year medical students how often they had followed a patient from imaging to surgery and ultimately, to the final pathologic diagnosis. Only 36% of students had followed a patient completely through this three-part process.

Historically, radiologic-pathologic correlation has been an Accreditation Council for Graduate Medical Education requirement of diagnostic radiology residency training. United States radiology residents have the opportunity to attend a 4-week rad path correlation course at the American Institute for Radiologic Pathology (AIRP). Residents submit a case that has a combination of radiologic images, gross surgical images, and microscopic images with pathologic confirmation (3). The case requirement of AIRP can serve as a model for the medical student experience.

There are different methods of including radiologic-pathologic correlation in the undergraduate medical curriculum. Jafri et al described a student-facilitated rad path correlation conference that was held as part of the radiology departmental conference (4). We expanded on this idea by creating a standalone elective that would allow students to prospectively follow multiple patients across the radiologic evaluation, surgical procedure, and pathologic diagnosis, thereby reinforcing the importance of basic science knowledge and interdisciplinary teams to clinical medicine. With the cooperation of the radiology, surgery, and pathology departments, we developed a 4-week elective.

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TABLE 1. Rad Path Learning Topics

I. Basic approach to lesions (solid vs cystic, patterns of growth/spread)
II. Liver
  a. Segmental anatomy
  b. Diffuse liver disease
  c. Focal liver disease with discussion of hypervascular and hypovascular tumors
III. Kidney
  a. Discussion of solid vs cystic renal lesions (Bosniak criteria)
  b. Ball vs bean growth of renal lesions (exophytic vs infiltrative)
  c. Tumor tipping points and staging of RCC
  d. GU alphabet soup
IV. Breast
  a. BIRADS
  b. Descriptions of calcifications and masses on different modalities
V. Chest
  a. Lung tumors, staging and mechanisms of spread
  b. Cavitary lesions
VI. Neuro
  a. Approach to lesions (ie solid vs cystic; intra-axial vs extra-axial)
  b. Ring-enhancing lesions of the brain
VII. Thyroid
  a. Types of thyroid cancers
  b. Ultrasound FNA of thyroid lesions and sonographic features of thyroid cancer

BIRADS, breast imaging reporting and data system; FNA, fine needle aspirate; GU, genituourinary; RCC, renal cell carcinoma.

TABLE 2. Recent Case Log

2 Whipple Procedures for pancreatic cancer
2 Needle localizations with lumpectomies
1 Craniotomy for a Masson's tumor
1 Thoracotomy for lung CA
1 Cystoprostacetomy for invasive bladder CA
1 Robot-assisted sigmoid colon CA resection
1 Ovarian CA debulking
15 Image-guided biopsies (breast MRI, thyroid, renal, lung, liver)

CA, cancer; MRI, magnetic resonance imaging.

TABLE 3. List of Multidisciplinary Conferences

General tumor board
Gynecologic rad path tumor board
Breast rad path tumor board
Pancreatic conference
Chest conference
Foregut/Esophageal conference
Endocrine conference
Neuro rad path conference

The structure of the rad path electives developed at our institutions share common threads including baseline instruction in imaging and pathology topics, student identification of case material and patient workup, review of imaging, observation of procedures, review of pathologic material, and creation of a formal presentation of the case. The students at Allegheny General Hospital (AGH) receive a list of topics that afford great radiology and pathology correlation (Table 1) as well as supplemental articles from Radiographics about those topics. Students at Medical University of South Carolina (MUSC) are given presentations on the basics of imaging, pathologic stains, and specimen preparation.

The specific curriculum for a given 4-week course varies from month to month as it is inherently dependent on the surgical schedule and available clinical case material. Review of the surgical schedule provides a ready source of potential cases. At AGH, the medical student identifies the surgical cases that he/she wants to see in a given week and reviews the appropriate imaging with a radiologist or radiology resident before the surgery. The student interviews the patient preoperatively and observes each surgery (Fig 1). In the pathology laboratory, the student helps the pathologist with the orientation of the gross specimen and assists with slide preparation for the frozen specimens (Fig 2). The student will then follow up with the pathologist over the next several days as additional slides and sections are reviewed. A typical student can participate in 8–10 surgeries and 15 or more image-guided biopsies. A recent student log is included in Table 2.

At MUSC, in addition to the surgical schedule, students identify potential cases during required attendance at tumor boards and multidisciplinary conferences (Table 3). Case preparation is predominantly completed through independent study and research, with consultations with resident and staff radiologists and pathologists as needed. As structured, this elective gives the student flexibility to dig deeply into topics or disease processes of particular individual interest.

Participation in image-guided biopsies provides the student with a unique educational opportunity for radiologic-pathologic correlation with immediate feedback. At our institutions, a cytopathologist is present during all image-guided biopsies. The radiologist reviews all relevant images with the resident and medical student before doing the procedure. A differential diagnosis and plan for safe biopsy are discussed. During the biopsy, all samples are reviewed with the pathologist. The radiologist, the resident, and the student answer the following specific questions: Is the specimen adequate? Is the preliminary pathologic diagnosis concordant with our radiology differential diagnosis? The student then follows up to learn the final pathological diagnosis.

Mammography and needle localization provide additional opportunities for rad path correlation. With needle localizations, a student has the opportunity to review the relevant images and work up with the radiologist prior to the needle localization. The student observes the needle localization and

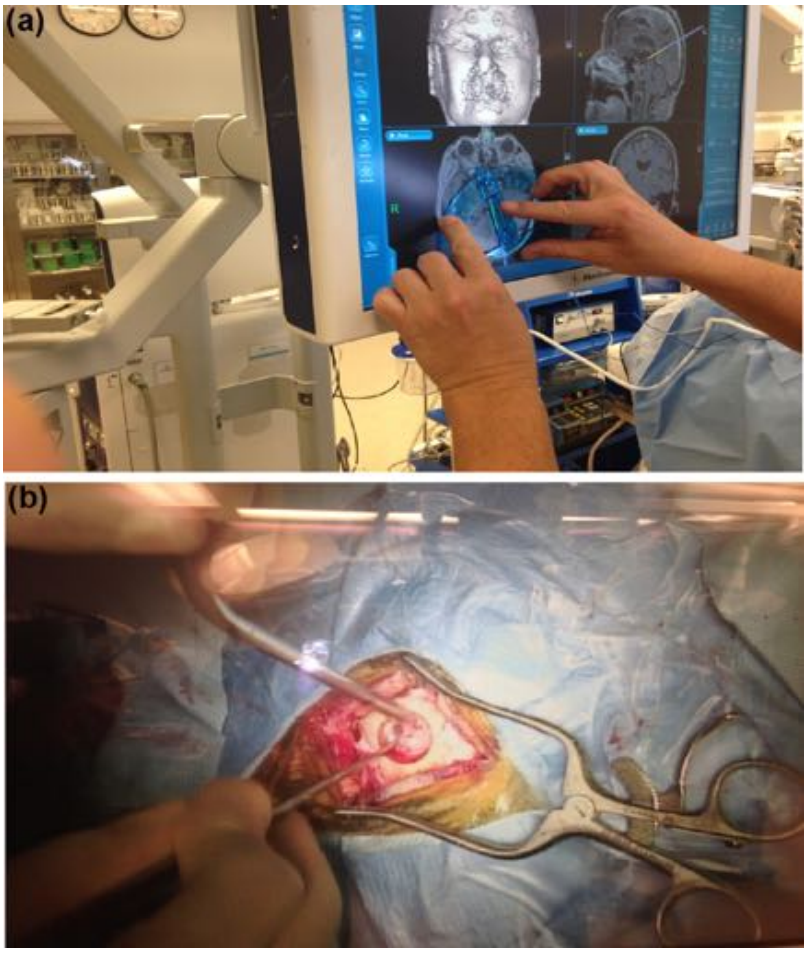

Figure 1. A student participates and watches an image-guided intraoperative biopsy of a brain lesion using the computer-assisted software for lesion localization (**a** and **b**).

proceeds to the operating room with the patient. The student returns to the radiology department for confirmation imaging (ie were the breast calcifications removed). The student then helps the pathologist with the slide preparation of the final sample for final diagnosis.

At both institutions, the course culminates with a formal 20-minute radiologic-pathologic clinical presentation. At AGH, this is a noon conference for the radiology residents and students and incorporates the ACR Appropriateness Criteria. At MUSC, the students present to the course directors and their peers in the fourth-year Diagnostic Radiology elective. The formal case presentation affords the student the opportunity to develop effective audiovisual materials and to improve oral presentation skills.

Students are exposed to the critical roles of the radiologist and pathologist in clinical medicine through attendance at

Figure 2. A student helps with the slide preparation from a frozen sample of the brain lesion.

Figure 3. An attending radiologist goes over the imaging findings on a patient with pancreatic cancer at the pancreatic conference.

multidisciplinary conferences (Fig 3). For example, during the weekly AGH pancreatic conference, 7–10 pancreatic mass cases are presented. The conference is attended by clinicians from gastroenterology, radiology, surgery, radiation oncology, medical oncology, and pathology. Relevant images, as well as all biopsies and surgical pathology results, are presented. Consensus treatment recommendations are made. Students report that they have a better appreciation for the importance of radiology, surgery, and pathology after attending these conferences.

The elective provides an excellent source of teaching file material. Completed cases provide a source for independent study by future medical students as well as residents and faculty. Residents have an incentive to help the students throughout the 4-week elective because those attending the AIRP are required to bring a rad path case, which has both gross and microscopic pathologic correlation. In addition to identifying a potential AIRP case, the residents get to improve their teaching skills and develop an opportunity for publication.

The elective is a unique opportunity for students to publish a case report. Although most medical students will not pursue an academic career, the case report is an outstanding educational experience for learning what is involved in the preparation of a manuscript. The proliferation of electronic journals increases the likelihood of publication. MUSC students have had two case reports accepted thus far, with two more in preparation. AGH students have had one case report accepted with several more in preparation. Whether accepted for publication or not, manuscript preparation is an invaluable exercise in honing skills of organization, critical thinking, thoughtful literature review, and precise writing. In addition, preparation of a manuscript provides the student with insight into the effort involved and difficulties encountered throughout the publication process.

DISCUSSION

Although many of the students taking the course are interested in a career in radiology, the primary goal of this elective is not to teach medical students how to interpret radiological images. Medical students interested in image interpretation for a career are encouraged to apply for a radiology residency. The goal of the rad path elective is for the students to appreciate the value of effective multidisciplinary work of a team of practitioners and its potential positive impact on the quality of patient care. Interprofessional collaboration is an important skill for a physician in any specialty. Each member of the team adds specific expertise to assure this quality care. Clinicians evaluate the patient and order appropriate clinical and radiologic studies, the radiologists interpret images and often perform biopsies, the surgeons remove diseased tissue, the multidisciplinary conferences offer expertise in optimal management, and the pathologists render final diagnosis.

Medical students embrace learning when they are active participants (5). The level of knowledge and understanding with active learning is much greater than that with passive learning typical of the traditional didactic lecture. For satisfactory completion of the elective, the student is required to complete many independent tasks outlined previously, necessitating student engagement and active learning.

The response from this rotation has been extremely positive. MUSC has had 16 students who participated in this rotation over the past 2 years. Students report high levels of satisfaction with the course with respect to integrating material across different specialties. Interdisciplinary conferences were cited as a major contributor to the educational experience (Fig 4). One MUSC student commented, “It was great seeing how imaging and pathology work together to come

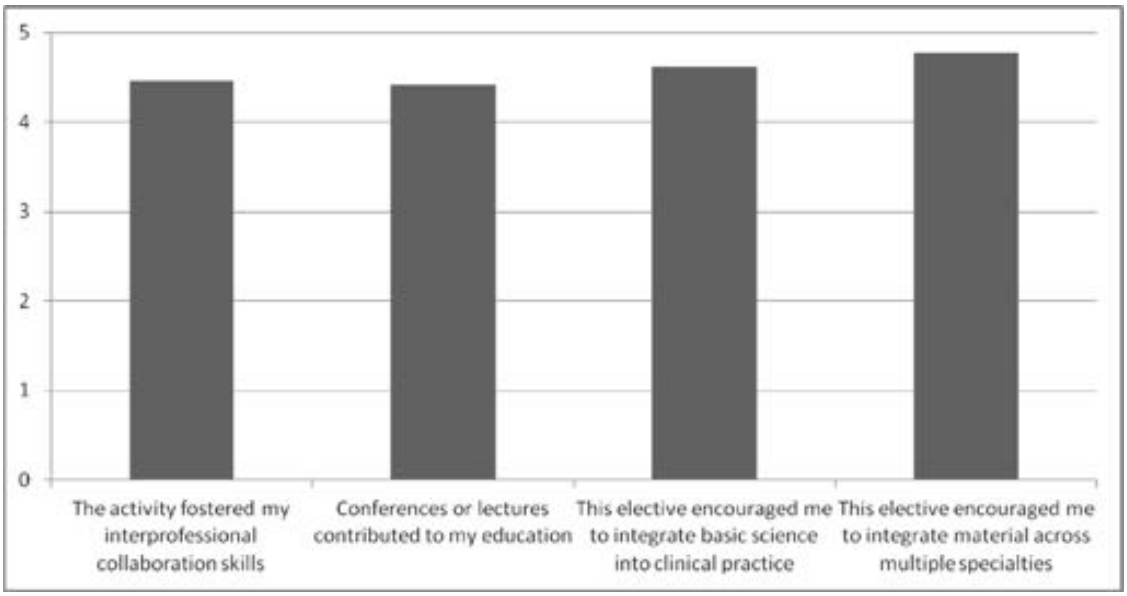

Figure 4. A total of 13 students from Medical University of South Carolina evaluated the course on a 5-point Likert Scale (0 strongly disagree to 5 strongly agree).

up with a diagnosis given a patient's history and physical. The independent nature of this rotation was excellent and did a good job of coming up with good learning experiences. The tumor boards were interesting as well." Another said, "The rotation gives exposure to really interesting/rare cases and allows the opportunity for potential case reports." Finally, one student described the rad path elective as "One of the best courses I've taken at MUSC." Free text responses from AGH were also very positive. One student said, "This was one of my favorite rotations in medical school." Another student mentioned, "I took the opportunity to see some awesome neurosurgery cases, which I hadn't been exposed to as a third year medical student." Another student added, "I've already recommended this class to a bunch of people. It's a great way to see continuity between cases."

The opportunity to expand and improve this elective exists. We are constantly adding to our teaching files and modifying our learning objectives. The majority of the students taking this elective have previously taken the basic radiology elective. For students for whom this is their first radiology rotation, special attention and extra time are spent explaining the radiology basics and learning objectives and competencies from the Alliance of Medical Student Education in Radiology.

In summary, we have created two similar radiology-pathology electives that enable students who are interested in radiology, pathology, or surgery to increase their knowledge of each of these specialties, to be active and independent learners, to develop a greater understanding of the value of multidisciplinary teams to patient care, to improve oral presentation skills, and to gain potential experience in research and publication.

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