OPINION ARTICLE

Integrative Diagnostics Approach—A Contemporary Learning Methodology at Medical Schools

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Abstract

Paul L Foster School of Medicine is adopting a clinical presentation based curriculum that encompasses an approach of teaching clinical knowledge, medical skills and diagnostic imaging to the first and second year medical students. This approach may help our students to better integrate knowledge they acquire during the first two years of their medical education into the years of clerkship, residency and beyond. We believe that early integration of different medical imaging modalities and basic science disciplines, in particular the anatomy and pathology, may lead to more efficient use of medical technology and cost beneficial medical practice in the future.

Keywords: Medical imaging, pelvic ultrasound, basic science disciplines, anatomy, pathology.

INTRODUCTION

Diagnosis is an art, which comprises of an integrated approach involving:

A. Clinical skills (history taking and physical examination)
B. Pathology and laboratory
C. Medical imaging

Traditional medical curriculum offers step-wise approach to diagnostics. It encompasses study of normal anatomy, histology, physiology and biochemistry in year one; microbiology, pathology and pharmacology in year two. While students may have gained strong control over pathology and laboratory medicine by the end of year two, they are yet to examine a patient, or understand and interpret radiological images. Hence, two out of three elements for an efficient diagnosis are missing during the first two years of medical school in the traditional approach. In essence, at the end of their preclinical education, medical students trained in the traditional curriculum are nowhere close to an integrated approach. It is beyond the scope of this article to provide critique of the traditional medical education, and that certainly is not the intent of the authors. The idea is to convince the readers on the availability of an alternative approach that is more efficient, effective and economical (time-wise).

At Paul L Foster School of Medicine (PLFSOM), we are offering an unorthodox perspective of medical students' education in years one and two. In other words, we are rewiring the medical education. The traditional curriculum can be euhemerized to "an arrangement of batteries in a series within a circuit". Our curriculum is then akin to "an arrangement of batteries in parallel". We all know that the resistance offered by a parallel circuit is manifold lower than offered by a series circuit. If we assume knowledge was transferred this way, our brain would offer least resistance and most conductances to PLFSOM curriculum. This article addresses our approach on teaching diagnostics to medical students in years one and two of our curriculum.

Element 1: The Art of History Taking and Physical Examination

Taking a good history and performing a detailed physical examination are golden arts, usually taught during the clerkship years. In PLFSOM curriculum, first and second year medical students practice history taking and perform

physical examination on standardized patients under expert supervision. Objective structured clinical examination (OSCE) activities are organized on weekly basis to promote and test clinical skill performance and competence in skills, such as communication, physical examination, and interpretation of the laboratory results related to the specific clinical presentation. This approach has multiple benefits:

A. It allows the students to be exposed to a hospital-like environment from day one.
B. It allows students to acquire their own style of communication with patients.
C. It hones in their ability to take a focused history and perform a focused physical examination, an essential component of emergency scenes, where time defines life or death.
D. It puts what they are learning in texts in perspective, provides them the reason, the incentive and the motivation to understand both the normal, biological and abnormal;, pathophysiological processes.

Taking a good history, followed by a thorough physical examination, fundamentally defines the route the physician is going to take, or at least, he/she should. The fact of the matter is, this is a rate limiting step, and if used effectively, it can eliminate cost, reduce risk, improve outcome, and allow a trusting doctor-patient relationship to form.

Element 2: Clinical and Anatomical Pathology

This takes us to the next step in diagnosis, the role of laboratory medicine and imaging. At times, laboratory medicine precedes imaging, at other times, it follows. At all times, they form a formidable force that allows the physician to take the next course in management. In PLFSOM curriculum we are offering a spectrum of experiences to strengthen the medical student's knowledge of laboratory medicine. Three components of pathology curriculum in our institution include:

A. Pathophysiology
B. Laboratory medicine
C. Virtual microscopy (histology and pathology)

Pathophysiology is tackled through interactive lectures, seminars and team based learning modules, which stem from interesting clinical vignettes as well as latest hot off the press research and advances in diagnostics. Laboratory medicine component is based on understanding and interpreting normal and abnormal laboratory values in clinical medicine. Both components are closely linked to and are derived from the preceding anatomy, physiology, microbiology and histology sessions, allowing for full-blown integration of basic and clinical sciences. The aim of such an approach is to provide a seamless and smooth transition from normal to abnormal process. The third component of our pathology curriculum involves virtual microscopy system (by Bacus laboratories Inc, a wholly-owned subsidiary of Olympus America, Center Valley, PA, USA).[1,2] The database is comprises of several thousands of digitally captured glass slides providing you the experience of browsing through a traditional glass slide at the comfort of your home/work.

We have chosen this approach over traditional microscopy sessions, because it is very user-friendly, it does not have a space, or a time barrier to it. Students can access these sessions under a secure server within or away from the campus, and have the ability to browse through high resolution slides. The experience is akin to traditional microscopy, in the sense that students can browse through the entire slide and zoom in or out of the slides at several magnifications (up to 40X). The advantages over traditional microscopy are huge.

1. Faculty can use these real-time slides during their lectures to offer one of a kind experience to their students.
2. It allows faculty to compare and contrast normal and abnormal processes simultaneously amongst a large crowd, without taking time to switch sides, talk about them one at a time, or without a need to explain it to one student at a time.
3. Static images are no match to the power of virtual browsing that offers an in-depth real-time understanding of histology, as well as pathology.
4. Space is no barrier: students can access it via a secure server at any place (on or off campus). They do not have to be physically present for these sessions.
5. Time is no barrier: students can practice virtual microscopy at their free time, at their own pace.
6. Creation of image collections: students can create their own "high yield" image collections over time, and can review them before their boards or other exams.

Element 3: Medical Imaging

At every junctures, the students at PLFSOM will have access to radiological images, to correlate with the anatomy and pathology. The students will have the most unique opportunity to corelate the gross findings through CT and ultrasound images, volumes and DICOM (Digital imaging

and communication in medicine) information on their cadavers. This provides an opportunity to understand the field of radiology early on, compared to the traditional curriculum which introduces it much later. Another advantage is the ability of students to use it as an extension of and as an integral part of visual anatomy and gross pathology. For each course and unit in scientific principles of medicine our students are provided with images, which encompasses radiology, gross pathology and histopathology images. At each and every step, students have access to high resolution ultrasound images (2-D, color and power Doppler and 3-D ultrasound), computerized tomography (CT), magnetic resonance imaging (MRI), X-rays and other modalities of radiological imaging.

Element 4: Integrated Diagnostics Approach

Our methodology is exemplified in a case study of a 69-year-old patient presenting with abnormal genital tract bleeding. Such a patient has to be asked about the age and menstrual status (Fig. 1A). If the patient is peri/post-menopausal, the next step is to perform a pelvic examination to locate the site of bleeding (Fig. 1B). If it is determined that the source of abnormal bleeding is upper genital tract, the next step is to perform pelvic ultrasound to use pelvic ultrasound and determine the thickness of endometrium (Fig. 1C). If pelvic exam and Pap smear are normal, and endometrial thickness is less than 4 mm, atrophic endometrium should be considered. If endometrial thickness is exceeding 4 mm, endometrial biopsy should be performed to distinguish between endometrial hyperplasia, polyp and adenocarcinoma (Fig. 1C). In the case example presented,

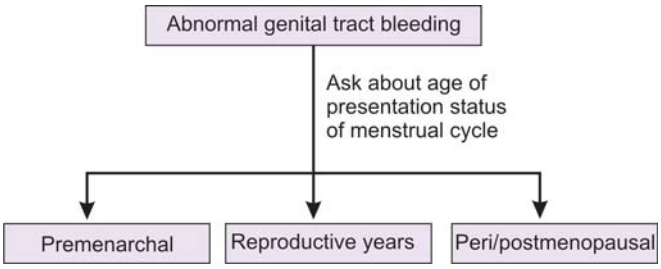

Fig. 1A: Algorithm of history taking in a patient with abnormal genital tract bleeding

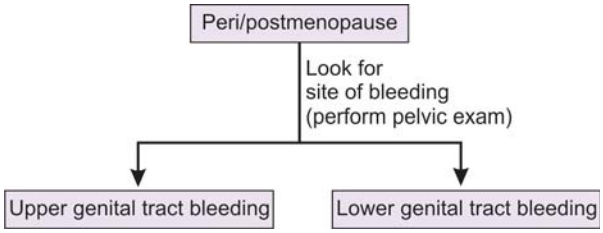

Fig. 1B: Algorithm of physical examination

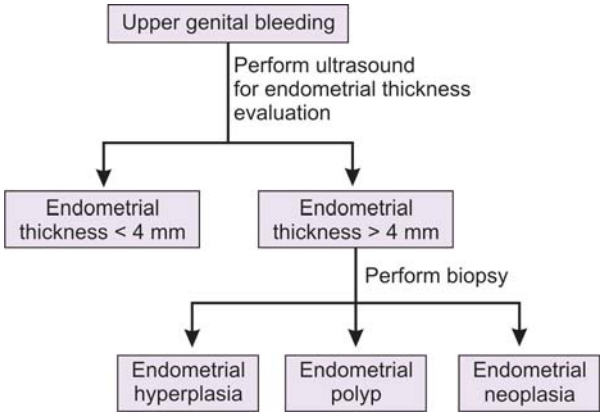

Fig. 1C: Algorithm of ultrasound examination and endometrial biopsy

Fig. 2A: Transvaginal color Doppler ultrasound of thickened endometrium in a postmenopausal patient. Note intense neovascularization within the endometrium

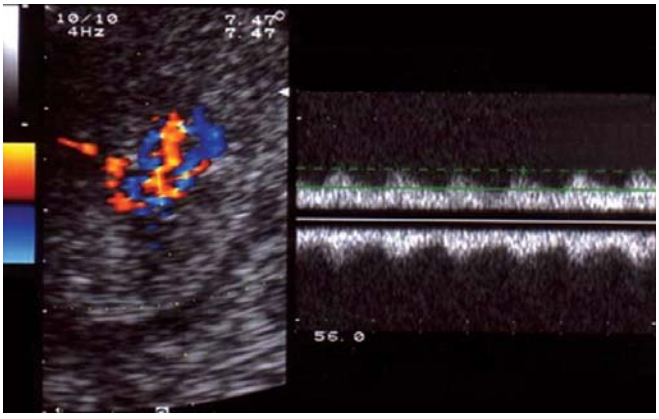

Fig. 2B: Pulsed Doppler waveform analysis demonstrates low vascular impedance (resistance index, RI of 0.37), consistent with neovascularization

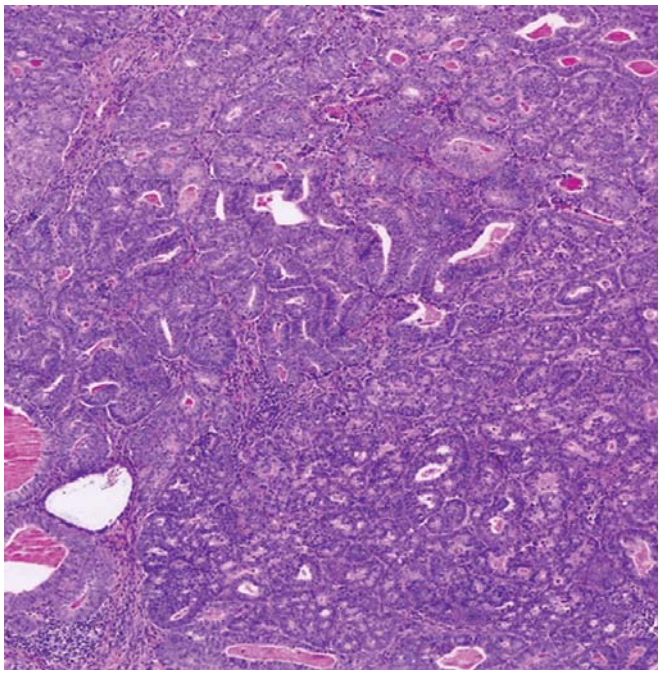

Fig. 3A: Well-differentiated adenocarcinoma

Fig. 3B: Normal histology of the uterine endometrium

transvaginal color Doppler ultrasound demonstrated abnormally thickened endometrium, measuring 12 mm, with area of neovascularization (Figs 2A and B). On biopsy, the patient revealed a "back to back" glandular arrangement and the nuclei were hyperchromatic.[1-3] The glandular structure was preserved. There was little or no stroma.[1-3] All the evidence pointed toward a well-differentiated uterine adenocarcinoma[1-3] (Fig. 3A). Figure 3B illustrates histopathological finding of normal endometrium.[1,2,4] Endometrial glands are nicely separated, with no evidence of crowding. The stroma is interspersed between the glands.[1,2,4]

CONCLUDING REMARKS

Young minds are impressionable. We predict our students will approach years three and four in a very different way. They would know how to take a focused history, how to perform a detailed physical examination, what tests, laboratory and radiological studies should be ordered, and how to approach a patient as a whole. We hope we are embarking a path that will help to create exceptional physicians and change the course of medical education in the future.

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