COMMENTARY

Should We Continue Teaching Anatomy by Dissection When . . .?

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The central role that human dissection has long held in clinical education is being reevaluated in many institutions. Despite the impression that many institutions are abandoning dissection, very few have and most of those have reinstated dissection within a few years. What are the inherent qualities that lead institutions back to dissection? In our efforts to redesign a shortened dissection course, our consultations with a broad range of clinicians lead us to understand how the rhythms of clinical practice are modeled and developed in the small-group setting of the dissection laboratory. Following further consultation with colleagues who have experimented with different models of anatomy instruction, we discuss three themes in support of dissection. First, problem-solving in the dissection laboratory develops the habits-of-mind of clinical practice. Second, relating dissection to imaging modalities develops the spatial reasoning skills needed to understand computer simulations, interpret imaging data, and interact with surgeons, radiologists, and patients. Third, the human face of dissection fosters self-reflection and integration of the cognitive and affective skills required for medical practice. Through group process, the collaborative effort of dissection teams develops essential of attributes of clinical professionalism. *Anat Rec (Part B: New Anat) 289B: 215–218, 2006.* © 2006 Wiley-Liss, Inc.

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INTRODUCTION

A colleague whose dissection program was under review recently posed this question on the Listserv of the American Association of Clinical Anatomists. The question ended with the phrase "when so many medical schools have abandoned it." Despite this inaccurate impression commonly held by medical school administrators, we should recall three facts: few schools have abandoned dissection; most schools that abandoned dissection later reinstated it; and educational innovations are often made with little effort to assess their impact. Nonetheless, compelling reasons demand we review what is known about the efficacy of dissection.

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Medical school administrators are rightly concerned with the management of time and control of costs in their educational programs. The science and technology underlying medical care is ever growing, and there are increasing concerns that schools should devote more time to ethics, professionalism, and humanism. Many laudable topics compete for time in the curriculum. Meanwhile, students leave school with ever increasing debt, yet tuitions only meet a fraction of the costs to educate them. In the face of such challenges, anatomy courses and body donation programs come under intense scrutiny as long, labor-intensive, and costly.

A few of the new medical schools are minimizing or eliminating dissection. For instance, Peninsula Medical School in the United Kingdom teaches anatomy using imaging modalities and living models (McLachlan et al., 2004). At the Cleveland Clinic Lerner College of Medicine of Case Western Reserve, a short first-year course is based on clinical cases and the examination of unembalmed cadavers (or donors, as we prefer to refer to the cadaver) that are dissected by residents (Drake, 2006). However, in this instance, students dissect in the second year by helping the residents prepare donors for the first-year class.

WHY DO MOST SCHOOLS REINSTATE DISSECTION?

One should carefully note that much attention is given when an established school gives up human dissection, or uses previously dissected cadavers for demonstration, but no attention is given when they reverse their decision. To our knowledge, this has happened at New York University, Uni-

versity of California at San Francisco (UCSF) and at Davis, University of Hawaii, and University of Washington. New York University's short demonstration (prosection) course was rapidly replaced with a full dissection course, because students' lack of understanding became apparent in subsequent years. Faculty at UCSF found that prosections led to minilectures that short-changed student-centered inquiry and exploration. Most students enrolled in elective dissection courses in their first or forth years, which they found more challenging and rewarding. Further, UCSF found that prosections were not cost-effective. Effective prosections are time-consuming for a skilled prosector to prepare and do not last long with a large class. Two years after their experiment, UCSF has returned to full dissection. Recently, UC Davis built a new medical education building that lacked a dissection laboratory with the intent of eliminating wet laboratories from the curriculum. Concerns were raised by clerkship faculty about the preparedness of students and how this decrease in small-group instruction would be viewed by the Liaison Committee on Medical Education (LCME), the accreditation board sponsored by the American Medical Association and the American Association of Medical Colleges. UC Davis is now building a new dissection facility. At Harvard, students instituted an anatomy club to dissect regions of the body that the core anatomy course omitted. The club evolved into an elective in which approximately half the class enrolls. An elective clinical-anatomy clerkship has been filled to capacity the past 6 years. These developments are leading Harvard to reevaluate its first course. The University of Washington made their dissection course an elective for several years, but reinstated it as a required course after nearly all the students elected full dissection. At the University of Hawaii, many students chose not to participate in dissection, but poor performance in the clinical years led to reinstatement of first a demonstration course and finally a full dissection course. These data suggest that top students will choose schools that continue dissection. Why? What is the inherent value of dissection?

The problem is we have surprising few data on the efficacy of traditional dissection programs or the programs that replace them. A review of the few reported studies emphasizes the inherent problems and equivocal nature of those studies (Winkelmann, 2006). When evaluations are not built into the design of a course revision, it becomes difficult to learn why the innovation succeeds or fails. The newer programs mentioned above are attempting to do such evaluations and we await their results. At Yale, we recently redesigned our anatomy course around clinical cases (http://info.med.yale.edu/surgery/anatomy) to address issues of time and cost, while maintaining a focus on pedagogy (Rizzolo et al., 2006). In our view, anatomy is one of the few remaining areas of the basic science curriculum where the habits-of-mind of the clinician are developed. We developed a clinically driven approach to help students bridge the transition from academic study to clinical reasoning. Our 4-year assessment of the new program is entering its last year and will be reported elsewhere.

Remarkably, deans around the country who have learned of our work presume that we have replaced dissection with clinical case studies and state-of-the-art computer applications. When asking advice on how to shorten their course and eliminate dissection, they are surprised to learn that dissection remains an integral part of our course. Our advances and applications of computer technology have been in support of dissection, not in place of it.

WHAT ABOUT DISSECTION IS SO VALUABLE?

We would like to explain why we decided to retain dissection as the central activity of our anatomy course. The themes we would like to develop are grounded on a literature that has been extensively reviewed (Dyer and Thorndike, 2000; Aziz et al., 2002; Rizzolo, 2002). That literature was amplified by colleagues who reviewed this essay or also contributed to the Listserv discussion and allowed us to incorporate their views (see Appendix). Most recently, Gunderman and Wilson (2005) reviewed arguments about how radiology and anatomical dissection can work synergistically to create a level of understanding that is difficult to achieve by either method alone. We would expand that argument to include many medical disciplines. To cite a few examples: physical diagnosis integrates anatomy with one of the students' first clinical courses, one that is often taught concurrently with anatomy. As sonography is becoming so inexpensive, imaging is becoming routine in physical examination. The peripheral nervous system is effectively taught by integrating dissection with common medical problems associated with the peripheral nerve examination, referred pain, gait and upper limb neuropathies, or the intended and unintended consequences of anesthetic nerve blocks. Even psychiatrists are using imaging technology. We and others have used surgical procedures to integrate dissection with radiology, pathophysiology, and how disease affects the activities of daily living. At the Albert Einstein College of Medicine, the anatomy course has been expanded to include organ and systems pathology conferences based on the student's findings on dissection of their donor. At the University of Utah, gross anatomy has been integrated into the histology and pathology programs by using gross findings and biopsies of their donor. Viewed in this way, dissection becomes a vehicle to introduce and relate anatomy to many medical disciplines.

What are the habits-of-mind of the clinician, and how does dissection help develop them? The rhythm of clinical practice is observation/history, taking to discover facts; interpretation of findings to develop a differential diagnosis; and development/execution of a management plan (Pangaro, 2006). The rhythm of the dissection laboratory is the same: observation to distinguish recognizable structures from unknowns; interpretation of what you see to develop a differential identification; and further dissection/exploration to distinguish between the possibilities of the differential identification. This process involves the scholarship, discussion, and teamwork that many schools try to promote through case-based, small-group formats (Clough et al., 2004).

Consider the dissection team who

asks whether they have found the vagus nerve or the sympathetic chain. Their question demonstrates a bit of knowledge that can be confirmed by asking what observations and interpretations lead to this differential identification. The team should be able to report on the carotid sheath and its contents. They should be able to note that the candidate is a nerve, not a vessel, but lacks the relationship with the anterior scalene muscle to be the phrenic nerve. They should be able to conclude that their dissection is not deep enough to see the brachial plexus, whose nerves would be oriented in a different direction. If it is that deep, they should be able to determine they have torn the sympathetic chain in dissecting the carotid sheath. Perhaps the team did not appreciate the significance of each of these observations and the conclusions drawn from them, but dissection creates the teachable moment. The activity combines secondary sources, texts, atlases, and computer activities with a primary research source, the donor. The activity engages all of the senses and thereby all of the learning modalities. Having consolidated their understanding by reporting to the instructor (much as interns report their initial findings to a supervising physician), the team can now debate what information they lack that will help them sort out their differential identification and what sources can provide that information. This emulates the clinical process of deciding which diagnostic tests, or more extended history-taking, to pursue. Looking for branches of the vagus nerve or swellings indicative of ganglia would emulate the clinical process of executing tests, evaluating the results, and completing a diagnosis. This rhythm is repeated time and again during the laboratory.

Second, no matter how sophisticated computer software may be, and despite the advances anatomists and radiologists have made in virtual and simulated anatomy, it is still a two-dimensional screen. Our research (Rizzolo et al., 2006) confirms that when radiology and dissection are combined, students develop a dynamic 3D mental image of the anatomy. Spatial reasoning is difficult. It is invaluable to explore the donor simultaneously with analysis of plain films, CTs, MRIs, and 3D reconstructions. Consequently, we placed a computer at every dissection table. Laparoscopic surgeons, who teach in our course, report that dissection has become ever more important, because they are always looking at a 2D screen of limited resolution, but moving instruments in a 3D space (and have tunnel vision!). Similarly, surgical simulators depend on a high level of 3D understanding of human anatomy. Many clinicians report that radiologists "see" things in films that they cannot. We believe it is because radiologists have successfully developed a 3D mental image with which they compare all images. While only a fraction of students will become laparoscopic surgeons or radiologists, the goal of the dissection laboratory is to develop the spatial skills that enable a competent clinician to interact with radiologists and surgeons, explain imaging studies to patients (who more and more view images on the Web), and demystify surgical procedures that they may ask their patients to undergo.

A third theme that was developed in the Listserv and in the review articles related to the human face of dissection. Along with the habits-of-mind discussed above, the attitudes of ethics, empathy, and humanism are embodied in the concept of professionalism. An entire issue of *Clinical Anatomy* (volume 19, July 2006) was devoted to how anatomy education can further the development of professionalism. Certainly, there are many venues where schools can and should address this concern of the LCME, because professionalism cannot be relegated to one course or a subsection of another. Professionalism must be part of the culture of medical education.

A purely radiographic/computer simulation course would replace the human face of anatomy with an abstraction that would deny students a crucial opportunity to reflect on the feelings of mortality, humility, and spirituality that dissection engenders (Gunderman and Wilson, 2005). The "living anatomy" described in one noncadaver course addresses aspects of professionalism in very important ways that are also addressed elsewhere in the curriculum (McLachlan and Patten, 2006). Nonetheless, similar activities in the preclinical years at Yale do not appear to inspire the depth of self-reflection or artistic expression that students exhibit at the Service-of-Gratitude that concludes our course (Rizzolo, 2002; Warner and Rizzolo, 2006). On the Listserv, Rich Clough spoke passionately about his similar experience. The review articles we have cited have explored the dimensions of this topic (Dyer and Thorndike, 2000; Aziz et al., 2002).

CONCLUSIONS

Each of our three themes emphasizes active, student-centered learning. Our approach has been to design lectures, workshops, and computer activities that support and enhance the rhythm of the dissection laboratory. Students appreciate this diversity because they all learn differently. Our research indicates endless variety in how students choose to use our various resources to prepare for laboratory or workshop. Nonetheless, by day's end, students have to become accustomed to the universal rhythm of clinical training.

On the Listserv, Janet Cope, Mark Teaford, and Doug Paulsen emphasized the transformative nature of dissection and its unquantifiable benefits. Here, we have tried to illustrate how transformation can occur on multiple fronts. One only has to attend a service-of-gratitude to hear in their own words how the experience of dissection, its challenges, its frustrations, its rewards, changes the way students approach problems, regard their colleagues, and view their purpose. The question of how much dissection is required to realize these benefits is debatable. Many schools are experimenting with ways to retain the benefits of dissection in the context of shorter courses or courses that are spread throughout the curriculum. The traditional dissection course that we grew up with can and must change with the times. By engaging in our own process of transformation, rather than avoiding it, our community can ensure that dissection will remain a cornerstone of the medical school curriculum.

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APPENDIX

Contributors to this commentary are as follows: Kurt Albertine, University of Utah; Bruce Bogart, New York University; John Clark, University of Washington; Richard Clough, Southern Illinois University; Janet Cope, Springfield College; Richard Drake, Cleveland Clinic College of Medicine, Case Western Reserve; Ian Johnson, University College London; Scott Lozanoff, University of Hawaii; Todd R. Olson, Albert Einstein College of Medicine; Douglas Paulsen, Morehouse School of Medicine; Mark Teaford, Johns Hopkins University; Kimberly Topp, University of California at San Francisco; Richard Tucker, University of California at Davis; Trudy Van Houten, Harvard University; Andreas Winkelmann, Charité Universitätsmedizin Berlin.

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