A Novel Cadaver-Based Educational Program in General Surgery Training

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OBJECTIVE: To describe the development of a cadaver-based educational program and report our residents' assessment of the new program.

DESIGN: An anatomy-based educational program was developed using fresh frozen cadavers to teach surgical anatomy and operative skills to general surgery (GS) trainees. Residents were asked to complete a voluntary, anonymous survey evaluating perceptions of the program (6 questions formulated on a 5-point Likert scale) and comparing cadaver sessions to other types of learning (4 rank order questions).

SETTING: Large university teaching hospital.

PARTICIPANTS: Medical students, residents, and faculty members were participants in the cadaver programs. Only GS residents were asked to complete the survey.

RESULTS: Since its implementation, 150 residents of all levels participated in 13 sessions. A total of 40 surveys were returned for a response rate of 89%. Overall, respondents held a positive view of the cadaver sessions and believed them to be useful for learning anatomy (94% agree or strongly agree), learning the steps of an operation (76% agree or strongly agree), and increasing confidence in doing an operation (53% agree or strongly agree). Trainees wanted to have more sessions (87% agree or strongly agree), and believed they would spend free time in the cadaver laboratory (58% agree or strongly agree). Compared with other learning modalities, cadaver sessions were ranked first for learning surgical anatomy, followed by textbooks, simulators, web sites, animate laboratories, and lectures. Respondents also ranked cadaver sessions first for increasing confidence in performing a procedure and for learning the steps of an operation. Cost of cadavers represented the major expense of the program.

CONCLUSIONS: Fresh cadaver dissections represent a solution to the challenges of efficient, safe, and effective general surgery education. Residents have a positive attitude toward these teaching sessions and found them to be more effective than other learning modalities. (J Surg 69:693-698. © 2012 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: surgical education, frozen cadavers, surgical anatomy, skills training, skills laboratory, surgical simulation

COMPETENCIES: Patient Care, Medical Knowledge, Practice Based Learning and Improvement

INTRODUCTION

Knowledge of anatomy and exposure are essential for surgical training and the practice of medicine.[1] While anatomy remains a core subject in the first year of medical school, time allocated to the subject and to cadaveric dissection are decreasing.[1-4] Interns entering our training program often lack an adequate understanding of basic anatomy and struggle to master applied surgical anatomy.

In 2009, we received a fortuitous opportunity when a prominent neurosurgeon on our emeritus faculty (W.J.P.) presented a vision for a cadaver-based program in surgical anatomy. His arguments were simple: (1) cadaveric dissection has been substantially abbreviated in most medical schools; (2) surgery is anatomical engineering, manipulation of a patient's tissues or organs to improve health or save a life; a thorough knowledge of anatomy improves a surgeon's efficiency and safety; (3) while anatomy can be learned from textbooks, atlases, computer models, and prosections, the most effective method is by dissection; (4) endoscopic procedures, largely replacing open approaches, are seen on a screen in two dimensions and limit opportunities for the surgical trainee to see and handle organs in three dimensions. Based upon these arguments, the essential vision was to create a laboratory where residents could learn anatomy related to specific surgical procedures by dissecting embalmed and fresh cadavers.

Our departmental leaders embraced this vision and recognized an additional opportunity: cadavers provide an exceptional modality for surgical skills training. Acquisition of technical proficiency

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outside of the operating room has become the paradigm in the current era of residency training,[5-9] and the Accreditation Council for Graduate Medical Education (ACGME) now requires that programs provide simulation and skills laboratories.[10] Cadavers are particularly appealing for learning surgical skills as most available models and simulators are limited by lack of realism (e.g., inanimate tissue models), loss of haptic feedback (e.g., computer or laparoscopic simulators), inability to simulate open procedures, and poor representation of human anatomy (e.g., animate laboratories).

Over the past 2 years, a series of surgical anatomy-based programs was introduced at UCLA as additional components of our educational programs for students, residents, and faculty (Table 1). These included a cadaver-based educational program to teach surgical anatomy and operating skills to general surgery trainees. Herein, we report upon the programmatic development and the results of a survey study to assess our residents' attitudes regarding the cadaver-based curriculum.

METHODS

Programmatic Development and Current Status

The present elements of our program (Table 1) include educational and research activities at undergraduate, graduate, and postgraduate levels. All are taught by the dedicated faculty member (W.J.P.) and faculty volunteers. Technical support is provided by laboratory personnel employed by the Department of Surgery. The graduate-level cadaver-based programs in general surgery are presented as components of our core weekly education conference,[11] except for the PG1 dissection program that was launched during the current academic year within a dedicated outpatient rotation.[12] The latter is a new program that was not in place at the time that the survey study was performed.

TABLE 1. Surgical Anatomy Educational Programs at UCLA

Level	Program
Undergraduate	
Preclinical (years 1 and 2)	Anatomy-based demonstrations, years 1 and 2 GI curriculum
	Suturing laboratory in year 2
Clinical (years 3 and 4)	Anatomy refresher sessions during year 3 surgery clerkship
	Surgical anatomy sessions during year 4 foundations course for students planning careers in surgery and related disciplines
Graduate	
All levels	Case-based anatomy demonstrations
Junior level (PG1-2)	Required cadaver dissections
	Skills training (basic techniques, chest tubes, others)
Senior level (PG3-5)	Case-based, discipline-oriented cadaver dissections
Postgraduate	
	Skills training: laparoscopic colorectal surgery, Ob-GYN, urology, plastic surgery
	New procedure development: hand transplantation
	Multiple current research projects

Cadavers are ethically donated according to the individual's legally executed, advance-directive bequest. Bodies are fresh-frozen at −17°C to 20°C and defrosted before use. Fresh-frozen rather than formalin-fixed cadavers were chosen because formalin fixation causes tissue rigidity and unrealistic tissue handling properties, loss of tissue texture color and consistency, loss of surgical planes and spaces, and difficulty in identifying small structures, such as nerves. Once thawed, the bodies are suitable for wide-ranging surgical simulation with high fidelity, realistic tissue handling. Within reason, specimens can be re-frozen for subsequent courses, thereby maximizing usage and cost efficiency.

Cost of cadavers represents the major expense of the program. The cost for an entire body is approximately $2500 (less if only the torso or other portions are used). All instruments have been donated by the hospital's operating room, our large animal facility, or the gross anatomy program. Personnel include staff employed by the medical school, as well as time that is donated by our surgical faculty. An additional cost, but not represented in this study, is the renovation of an entirely new space to conduct our sessions as we found that the currently used spaces could not provide full-time support for our programs. This renovation includes a 2100 square-foot facility comprised of a laboratory with 5 operating tables, each with 2 overhead lights, overhead pull-down suction, compressed air, and electric power, 3 wall-mounted flat screen monitors, an instrument preparation room with autoclave, a classroom with flat screen projection, offices for 3 assistants, and a locker room.

Graduate Cadaver-Based Educational Program

The program for our surgical residents utilizes a variety of formats depending on the goals of the session. For core general surgery procedures, faculty, residents, and medical students receive a lecture on the relevant surgical anatomy, followed immediately by demonstration of the procedure on a fresh cadaver. The demonstrations are performed by a clinical faculty member in our Medical School's autopsy anatomy theater, which has stadium-style seating around the dissection table and is equipped with an overhead dissection camera displaying the image on multiple large monitors. At the conclusion of these sessions, senior residents remain in the anatomy theater to review the dissection and perform additional procedures if desired.

For sessions designed to teach specific surgical skills, junior surgical residents in small groups of 4 to 5 are instructed on a