Transactions of the Illinois Academy of Science
(1986), Volume 79, 3 and 4, pp. 279-282

MINIMIZING RISKS AND MAXIMIZING BENEFITS IN THE GROSS ANATOMY LABORATORY

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ABSTRACT

The formaldehyde used to preserve cadavers may be harming some students and teachers in the gross anatomy laboratory. Merely reducing the hours spent in dissection would reduce the risk, but would also jeopardize the professional preparation of future physicians. If the gross anatomist in charge manages the dissection laboratory in the way hereafter described, dissection time can be reduced by a third at the same time that student performance can actually be improved.

INTRODUCTION

A study by Robert Spear of the University of California at Berkeley was interpreted by him and by Richard Wade of the California Occupational Safety and Health Administration to mean that formaldehyde was inducing chromosomal changes in medical students dissecting cadavers, according to news report in *The New Physician* (Anonymous, 1982). Even if the Berkeley report of sister chromatid exchange is never confirmed in other laboratories, and studies reporting sister chromatid exchange are notoriously difficult to replicate (Ciaravino et al., 1985), there have been other ominous studies suggesting what formaldehyde may be doing to some of the people exposed to it. For example, in anatomists the incidence of brain cancer is higher than in control populations not exposed to formaldehyde, according to N.E. Stroup (Levine et al., 1984). The likelihood that formaldehyde is responsible for additional toxic, mutagenic, and carcinogenic effects was mentioned in a study from the U.S. National Cancer Institute (Grafstrom et al., 1983). A link between formaldehyde and neurobehavioral and respiratory symptoms was pointed out by Kilburn's group (1985). No wonder Norwegian anatomists have stressed the desirability of embalming cadavers with preservatives less dangerous to dissectors than formaldehyde (Frolich et al., 1984).

Those who work with cadavers can no longer ignore such warnings or wait for regulatory safeguards to be legislated. Prudence would advise them to take precautions in the meantime, and to seek ways of reducing the hours spent in dissection, thereby reducing cumulative exposure to formaldehyde vapor and liquid, hopefully below threshold levels. There is a dilemma here, however, for would-be physicians and surgeons must acquire the knowledge of anatomy that comes only with dissection. It turns out, though, there is an escape from the dilemma, provided teachers and learners increase their efficiency in the laboratory. Our laboratory has made a beginning with the adoption of laboratory practices which permit the dissector to reduce dissecting time by a third without concomitant learning deficits—to six hours a week from nine hours a week, i.e., a reduction of 42 hours of formaldehyde exposure in the first half of a dissection course lasting 28 weeks. The principal innovation, appreciated by the students and referred to by them as a "Go-Round," can be described as follows.

METHODS

Every week the six students at a table choose, from a list of 20-40 important structures dissected that week, 4-6 they think are especially well-shown on their cadaver. Using pins whose heads are differently colored, they pin the chosen structures and place a color-coded key near by. Next they have their identification corroborated by the instructor, who may modify the display in order to (1) avoid undue duplication of what is better shown elsewhere; (2) make sure that each item on the list is pinned on at least one cadaver; (3) reduce the excessive scatter of pins by confining them to a particular region on one side of the cadaver so that students whose display has been approved can continue working on the unpinned side while waiting for the instructor to finish approving other displays; and finally, (4) make sure each display, by itself or in conjunction with others, conveys concepts and is not merely a collection of randomly pinned structures. For example, one display of the femoral triangle might pin its three borders—the inguinal ligament, the sartorius muscle, the adductor longus muscle— and its principal contents: the femoral artery, vein, and nerve. A second display might show the two muscles, pectineus and iliopsoas, which make up the floor of the femoral triangle and come into unobstructed view when the blood vessels and nerves overlying them are removed. Also pinned in the same display should be the insertion of the iliopsoas muscle into the lesser trochanter of the femur, the two divisions of the obturator nerve, and the adductor brevis and adductor magnus muscles. A third display could show how removal of the femoral triangle's veins and nerves uncovers its arterial tree: the femoral, deep femoral, lateral and medial femoral circumflex, perforating—to mention the larger branches. Other displays might point out items having great clinical significance: a probe inserted into the femoral canal to show the site where femoral hernias occur; a string tied around the great saphenous vein, which is sometimes used in coronary bypass surgery; enlarged inguinal lymph nodes; and so on, for 15 tables. When all the displays have been approved, the "Go-Round" starts. On command, each group of six students moves together to the adjoining table, where they inspect the display thereon for three minutes. They position themselves three on a side, and after about a minute switch sides so that each student views the display from two vantage points. They are instructed not to touch the displays and to curtail conversation. This process is repeated, again and again on command, until each group has viewed every table and, by following a definite itinerary through the laboratory, has arrived back where they started. Then for 15 minutes more, students are free to move about individually and look at whatever they please before the pins are removed. A "Go-Round" for 15 tables takes an instructor and two teaching assistants 45-75 minutes to organize, and 45-50 minutes more are required for 15 groups to move sequentially to 15 tables and spend approximately three minutes at each.

RESULTS AND DISCUSSION

As measured by their performance on practical examinations comparable in difficulty to those given in the past, the majority of students are now brought up to a level of performance that was attained by only a few students when the dissection course was taught in the traditional way. (Table 1) There is no reason to suppose that the students who now do better are brighter or have a better background than those that had been taught in the traditional way.

One can list six additional benefits of the "Go-Round." First, it forces every student to learn from every cadaver in the laboratory, and makes up for the fact that some students are handicapped by the cadavers assigned them: cadavers that are amputees, that have muscles atrophied from chronic disease or aging, that have viscera undissectable from cancer or missing after surgery, e.g., hysterectomy; that are obese to the point their oil-soaked blood vessels and nerves break and go unidentified during dissection; that are so fetid and repugnant that even conscientious students lose their motivation, and instructors and teaching assistants tend to bypass or spend less time at such a table. Second, the "Go-Round" enables students who are poor dissectors to learn from the dissections of classmates who are more skilled, more careful, more motivated, or more lucky. Third, the "Go-Round" makes it possible to have different dissection techniques used on different cadavers, and since no one technique shows all structures equally well, every student will see what each technique optimally shows. Fourth, the "Go-Round" compensates somewhat for the fact that instructors and teaching assistants tend to spend too much time with students they find congenial and too little time with those they don't. Fifth, because the students learn so much from "Go-Rounds," the time-honored practice of impressing the departmental embryologist, histologist, neuroanatomist, and immunologist into the service of the gross anatomy laboratory can be given up with impunity. While their presence makes the teacher-to-student ratio look better on paper, the dissection laboratory runs smoother without them. Their skimpy (cf. Skandalakis, 1984) knowledge of cadaver dissection is a source of embarrassment to themselves and, anxious not to reveal to the students how little they know of gross anatomy, they talk about almost anything other than the dissection at hand, and make themselves a magnet for students who will use any pretext to avoid working on the cadaver. This encouragement of shirkers is unfair to students who do dissect and detracts from the professional education of those who don't. Sixth, given the litigiousness of the times, the "Go-Round" is an institutional safeguard against the charge that the institution is culpable of a callous disregard for student welfare (cf. Smalky and Schor, 1984).

Although the foregoing account of the benefits of the "Go-Round" may have convinced some readers that "Go-Rounds" ought to be tried more widely, there are many gross anatomists who will resist changing their ways. There are indications, however, that gross anatomists may have to change anyway, however strongly they may object and whatever their objections may be. First, the U.S. Department of Health and Human Services held a "Consensus Workshop on Formaldehyde" in 1983. Second, the U.S. National Institute for Occupational Safety and Health could get around to arguing that the gross anatomy laboratory is a workplace for teachers, teaching assistants, janitorial and maintenance staff, not to mention students. Third, the U.S. National Science Foundation, the U.S. National Endowment for the Humanities, and the Hastings Center together sponsored in 1983 a symposium titled "Ethical Issues in the Management of Occupational Hazard." Given these portents, it is only a matter of time until the regulators turn their attention to the cadaver laboratory. There they will encounter the defenders of the status quo and of the traditional that the gross anatomy laboratory is Medicine's "boot camp" (cf. Starr, 1982), but the regulators will also find allies in enlightened educators like Harvard's President Derek Bok (1984), who said of medical education it is not" . . . fair to justify the status quo as some sort of test or initiation rite that will strengthen the character of students." If regulators encounter innovations such as the "Go-Round", they may conclude that there are ways of simultaneously safeguarding student health and optimizing student learning, if only one relinquishes the sadism, arrogance, and mismanagement that long have masqueraded as "building student character."

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Table 1. How students taught by "Go-Round" method performed on practical examinations as compared to students taught by traditional method.

Method	Number of students whose two practical grades totaled between: 40 - 49	50 - 59	60 - 69	70 - 79	80 - 89	90 - 100	Total Students
Traditional	1	5	13	25	29	3	76
Go-Round	0	1	4	6	30	34	75