Designing an Advanced Laparoscopic Surgery Training Center

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The explosive development of minimally invasive surgery has had a staggering impact on the hospital, operating room, and surgeon, as well as on the medical equipment industry and insurance carriers.[1] As a result of (1) the overwhelming demand by the public, (2) the potential of future developments of this modality, and (3) the progressive geometric influence that has spread to the various surgical subspecialties, unprecedented pressure has been placed on our systems for training, credentialing, developing, supplying, and evaluating changes in surgical technique.[2]

While most advances in surgery relate to new applications of existing skills, magnified surgery–whether microscopic or laparoscopic–entailed the acquisition of new, more complex skills.[3,4] As previous developments in operative laparoscopy have already demonstrated its tremendous practical value (i.e., reduced morbidity and shortened recovery time), more advanced procedures will be of interest to many surgeons. Once the proper skills have been attained, their application can be made clinically under supervision of an experienced preceptor. After skills have been mastered, the evolution of new applications can continue in the classic fashion.

Laparoscopic surgery involves inherent limitations and risks; therefore, training and regular practice are essential.[5] Operating in a two-dimensional field, viewing anatomical structures from an unaccustomed perspective presented through video-imaging, depending substantially on advanced technical instrumentation, their non-intuitive remote-controlled use, and reduced tactile feedback–all these add to the need for *thorough*, formal training. In addition to the surgeon's developing his own skills, he must also organize a team to be successful. This includes training the assistant surgeon, camera operator, biomedical technician, and other operating room personnel.

Conventional intraoperative surgical teaching is not recommended, as the high degree of manual dexterity required

cannot be learned casually.[6] Rather, the surgeon, desiring to become a skilled laparoscopic surgeon, has to develop special skills through hours of practice in the laboratory, using basic experimental models and exercises developed for each technique and procedure. A revival of interest in animal laboratories has occurred which has provided an ideal environment for skill development.[7]

Clinical proctoring on laparoscopic cholecystectomy in the private sector provided the initial training grounds for the early generation of laparoscopic surgeons. Later formal courses involving "animal labs" were developed by a few leaders of this group, and eventually the academic community joined in to regain its leadership role. Involvement by the medical industry has been an integral part of this training, and provided their involvement was supportive (i.e., providing equipment and instrumentation) and not dominating (i.e., converting the training of procedures and techniques into the training of product use and the development of dependence on them), a harmonious relationship existed and surgeons were not driven off track.[8]

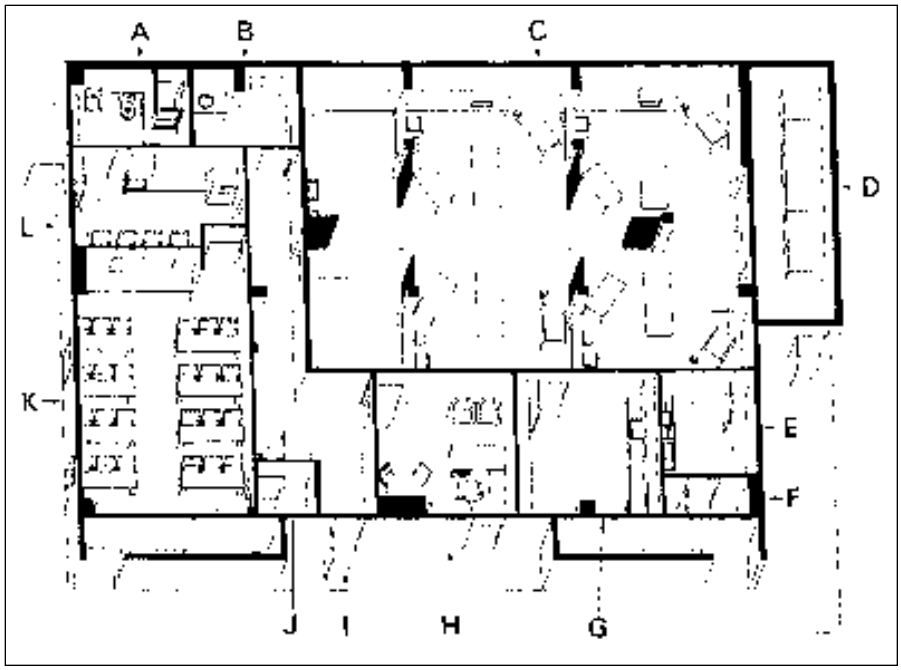

Figure 1. Schematic overview of the Center for Advanced Training & Research, Candler Hospital, Savannah, Georgia. From the upper left corner, proceeding clockwise: (a) bathroom with sink, toilet, shower; (b) changing room with sink and lockers; (c) animal lab with six stations (enlargements in Figs. 3, 4); (d) animal-receiving area with cages and separate entrance; (e) instrument cleaning & sterilization room; (f) janitorial closet; (g) storage and organizing room, with sink; (h) director's office; (i) front entrance and entryway with reception desk; and hallway with fire extinguisher and drinking fountain; (j) video control room adjacent to (k) classroom (enlargement in Fig. 2); (l) food preparation area with refrigerator, sink, microwave, counter, chairs, and separate entrance.

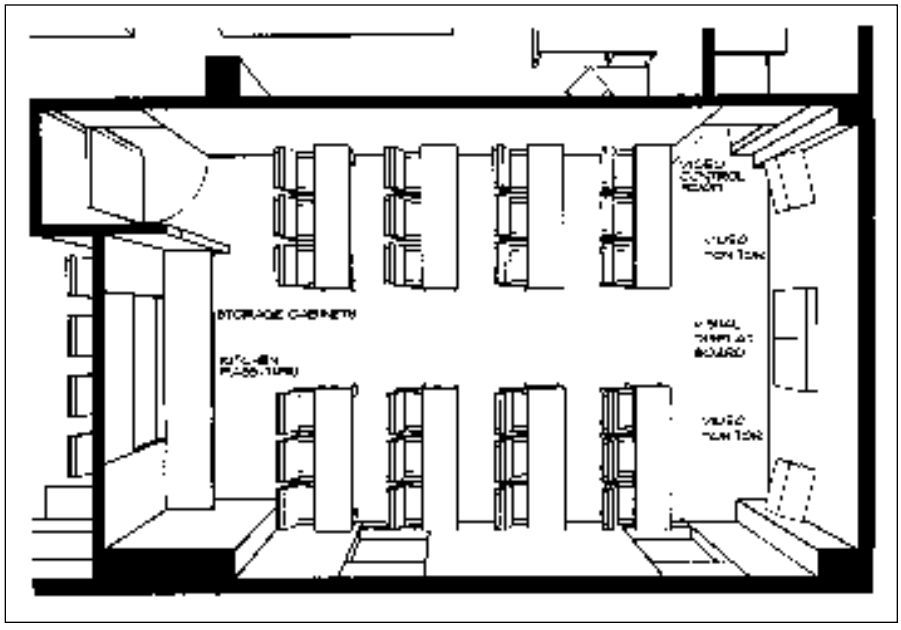

Figure 2. Schematic overview of classroom with two wall-mounted television monitors, visual display board (marker board and corkboard), and adjacent video control and storage room. Entrance to the classroom is located at the rear of the room, as are a counter, storage cabinets for serving refreshments, and a pass through to the Food Preparation Room which has additional counters and chairs (as well as a refrigerator, sink, microwave, and ice maker). Not shown is a lectern at the front of the room, a cart with a slide projector at the rear, and a public address system with wall-mounted speakers near the back of the room.

The hospital or university intent on establishing a full-service minimally invasive service needs to provide not only the clinical service but a full-time surgery laboratory permanently equipped with high-quality instrumentation and clinical video equipment. The factors that distinguish a dedicated facility from a multipurpose animal laboratory are not only the equipment and instrumentation, but also the staffing of the facility with personnel dedicated to a specific surgical modality (e.g., laparoscopic, laser, microsurgery, etc.), and a structured plan detailing the facility's organizational policy, planned activities, sourcing, funding, and goals. Such a facility provides a regional center specifically with a convenient and properly equipped setting for a surgeon to attend practice sessions that are convenient to his schedule, or to try new techniques, instrumentation, and equipment. It also provides backup services for the human operating room; it can also serve as a research facility if it has the capability of providing animal housing, whether on premises or at another location. Regulations require that facilities involving animals be in a location that is separate from areas where patients are to be seen and treated.

CONCEPTUAL PLAN

The need for an advanced surgical training facility at Candler Hospital originated from two local surgeons interested in teaching advanced laparoscopic surgery procedures.[9,10] Since the hospital was planning a redesign process to develop new focused-care services, including specialty centers and an

advanced surgery center, the concept of a surgery training facility was compatible with its redesign goals. Thus, the Center for Advanced Training & Research was initiated as a new project that was to complement the activities of the clinical services.

Several individuals were involved in developing an overall plan for formal activities, facilities acquisition, development, funding, equipping, sourcing, and staffing. After three potential sites were identified and studied, the hospital's board of trustees agreed to purchase a building adjacent to the hospital. The criteria considered were the building's accessibility to the hospital, low traffic area, low public visibility, costs, and availability. Consultations between the authors, each representing the clinical services (EDB), teaching and research activities (ZS), and the operating room (NJK) was conducted to determine the exact needs and best overall design for the given site. Other surgeons on staff, as well as other hospital personnel, veterinarians, etc., were also consulted as the architectural plans were being drawn and building permit applications submitted.

LAYOUT

The final blueprints (Figs. 1-4) involved modifications from the original plan to include a larger classroom (to accommodate 24 participants) (Fig. 5), a smaller reception area which allowed room in the director's office for a conference table, a reduction in the size of the food preparation area, and the inclusion of a pass-through area (Fig. 6). Two unisex bathrooms with shower and lockers were included, as well as clean and soiled utility areas and a janitor's closet. The facility was designed similar to a recovery room setting. The laboratory area allowed for six separate surgical stations, with half-height walls between each to allow some privacy which is conducive to focusing the surgeon's attention (Figs. 7-9). Special attention was paid to providing adequate space and to create an uncluttered operating environment.

The laboratory included scrub sinks, counter space, and cabinets which accommodated the storage of supplies and an area for the video equipment, obviating the need for video carts. The air conditioning/ventilation system was designed to accommodate increased air flow necessary to eliminate the odors usually associated with animal laboratories. Appropriate plumbing and electrical needs were also planned.

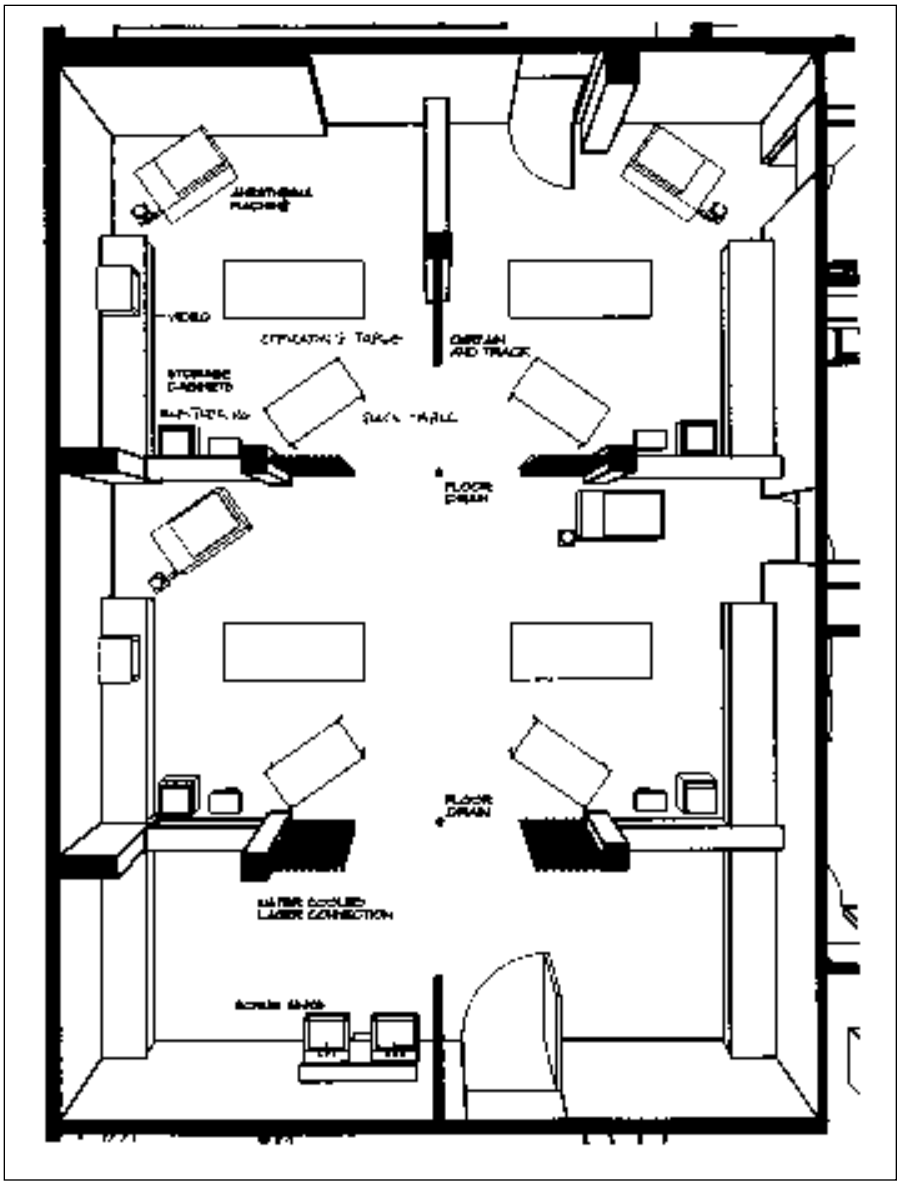

Figure 3. Schematic overview of the laboratory area with six work areas. Four of the stations are shown equipped a standard operating table, anesthesia equipment (inhalation), video monitor, counter (where additional video equipment is placed), storage cabinets, electrosurgery generator, utility cart, and back table. A half-height wall with curtains divide each of the workstations and a full-length curtain mounted on ceiling when drawn can completely enclose a workstation, if desired.

The holding area was designed to have a private entrance, with limited visibility from surrounding properties. The entire facility is fenced, including a privacy fence around the animal delivery area. The cages (Fig. 10) were planned with waste drainage in mind. A flushing system would allow for easy cleaning at the end of the day.

The building is equipped with an alarm system and motion detectors for security of equipment and facilities. The rooms were keyed to allow use of the classroom and kitchen area without enabling access to the laboratory area.

FURTHER PLANNING

Once the blueprints were finalized and the renovation scheduled to begin, development of the operating budget based on projected courses, supplies, salaries, etc., could be determined. Since so much time was absorbed in the initial phase of planning, courses were scheduled to begin shortly after construction was due to be completed.

Much planning is required to develop an annual calendar. Physician assessments were performed to determine

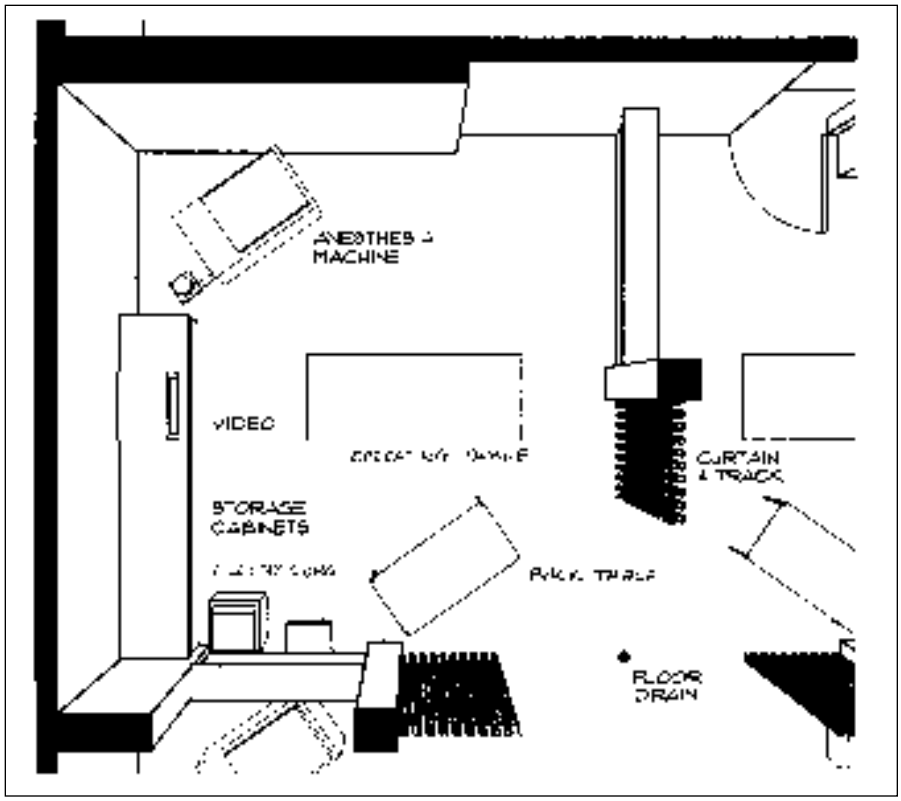

Figure 4. Enlarged schematic overview of a single laboratory station.

their specific training needs and other programs were recommended by laparoscopic surgery commercial representatives. A preliminary calendar was established and efforts were initiated to formalize course programs, directors, faculty, and other logistical arrangements.

Since Candler Hospital was not a provider of continuing medical education (CME) credits at the time the project was developed, joint sponsorship of programs has been established with other accredited organizations. The hospital had identified sponsorship of CME programs as a corporate goal for 1995 and has therefore been endeavoring to become its own provider.

EQUIPMENT AND SUPPLIES

Liaison with Instrument Companies: Developing a working relationship with the local and regional representatives of medical equipment and instrument companies was vital, not only to defray operating expenses but also to make available for the program a great variety of new and innovative instrumentation and for hands-on evaluation and side-by-side comparison for the surgeons. Basic equipment and instrumentation was sought from top companies and a uniformity was sought to minimize confusion that may arise with mix-and-match equipment. Karl Storz Endoscopy America agreed to provide video equipment, cameras, non-disposable instruments, and irrigation pumps based on the types of courses given. Major items to be ordered included veterinary tables, electrosurgery generators, OR equipment (back tables, mayo stands, stools, etc.) Inhalation anesthesia equipment, although a more costly setup than intravenous anesthesia, was associated with lower mortality in animals, and was therefore included on the acquisition list. The overhead surgical lights and anesthesia machines were provided by the hospital's operating room, as it had recently purchased new equipment.

An inventory list of necessary supplies was prepared as well as arrangements made for catering, marketing, veterinary services, suture supplies, etc. The operating room at Candler Hospital was instrumental in providing supplies at no cost to the Center, including disposable items which were opened but not used. These supplies included items such as gloves, drapes, tubing, anesthesia circuits, water bottles, and catheters. Purchased supplies involved anesthesia drugs, dietary items, scrub clothes, and office items.

PERSONNEL

The Director of the Center is the one full-time on-site employee. The director's responsibilities are to coordinate and oversee the day-to-day operations of the Center, as well as act as liaison to the Medical Director, the hospital administration, and other individu-

Figure 5. Classroom.

Figure 6. Food preparatory room with pass through to the classroom.

Figure 7. One side of the laboratory area with three of stations shown during an advanced laparoscopic suturing course using inanimate models in laparoscopic trainers.

Figure 8. A single laboratory station shown during live porcine surgery in an advanced laparoscopic suturing course.

Figure 9. Live porcine surgery.

Figure 10. Animal-holding cages and floor draining system in the Animal Receiving Room.

als involved with the Center. Additional services are contracted on an as-needed basis, including veterinary, secretarial, nursing, janitorial, food services, engineering, and other services.

COSTS

The estimated cost of the project was approximately $300,000 for the property (building) and $200,000 for renovation and some furnishings such as an ice machine, refrigerator, microwave oven, lockers, tables and chairs in the classroom, a reception's desk, and a conference table. The director's office furniture came from an existing office in the hospital. Capital expense monies covered the cost of laboratory equipment, a plain paper fax machine, and suction machines for each laboratory station.

All equipment was ordered with an estimated time of delivery to coincide with completion of the renovation. The hospital's legal services department was consulted to devise contracts with faculty, caterers, marketing department, and print shop.

The course preparation process was streamlined to increase efficiency and to facilitate training of other personnel as necessary. Job descriptions and an orientation program were developed. Policies to cover administration issues were written to comply with the U.S. Department of Agriculture (USDA) guidelines. Protocols were developed and procedures written to cover all aspects of the Center.

Regulations and standards covering training and research facilities were obtained from the USDA and were used to develop the Animal Care and Use Committee.[11,12] This committee would be responsible for approving course protocols as related to animal use and for overseeing the general welfare of the animals used.

With respect to the possibility of protests from animal rights groups, the Vice President of Public Relations and the Vice President of Marketing were consulted to devise a strategy if such a need arose. A dialogue was developed for use when discussing the Center, its courses, and other activities with anyone, especially representatives of the news media. This proved to be a vital point since members of the local daily newspaper were present for an interview on day one of the Center's first course.

One of the hospital's general surgeons was contracted to serve as the medical consultant for the Center's programs. His responsibilities included developing long-range goals, overseeing program development, participating in teaching programs, and serving as a member of the Advisory Board for the Advanced Surgery Center to coordinate the activities of the Center with that of the hospital's programs.

The operating budget was discussed with this medical consultant. Because the initial budget presented in the pro-

posals was formulated on a break-even basis, the 1994 operating budget was an estimate, based on projected courses to be offered that year.

The Center did not open until mid-August 1994, with the first course scheduled for late September. The 1995 operating budget was developed in much the same way as the one for 1994 because very little information was available to determine actual costs. The Center has avoided excessive dependence on commercial entities to avoid compromising the academic quality of programs. Revenues were based on expected course participation, but the Center was not expected to break even until 1996.

One concern of the Medical Director has been that revenues may never meet the expectations of the hospital administration. Expenses are monitored on a monthly basis, and are held to a minimum, but course quality is not compromised for the sake of a break-even budget. No program can survive without the support of the hospital administration and the medical staff. It is important to provide quality programs that are relevant to present and future technology, which are offered at reasonable rates, and which provide CME credits. The Center for Advanced Training & Research is striving to accomplish these goals. The next steps include encouraging the development of research projects and of training videotapes of new procedures.

The Center has been open for nearly one year and 22 courses have been conducted involving six surgical specialties (general surgery, gynecology, urology, otolaryngology, orthopaedic, and pediatric surgery). Current programs are continually being evaluated and new programs are under current consideration. Candler Hospital's physicians have been instrumental in providing the leadership necessary for a successful program, as has been the cooperation of the medical/surgical industry which also utilizes the facilities for skills labs, new equipment training, and development of new procedures, thereby providing a source of additional funding.

Plans include promoting preceptorships with local physicians, developing a library of teaching videotapes, and developing new techniques in all areas of laparoscopic and endoscopic surgery.

CONCLUSION

A clinical service supported by a training facility is an indication of the community's and the hospital administration's commitment to enter properly prepared into this new phase of healthcare. The Center for Advanced Training & Research was planned and designed to offer a facility for surgical practice and training to minimize the complications that are inevitable when a new surgical approach is developed and adopted over a relative short period of time. The requisite skills involve classic surgical skills pressed to a higher level due to the modified access. As important as laparoscopic surgery has become, the entire community has not yet become convinced of its relevance (e.g., the medical insurance sector, credentialing committees, etc.).[13] It is therefore vital that any surgeon embarking in advanced laparoscopic surgical procedures be as well trained as possible, starting with participation in a formal training course. Having a facility in which to practice and/or test new or different approaches and to test new devices or instruments outside of the operating room is of great value. The experienced surgeon is then better prepared to apply new concepts, approaches, and technology and is more able to differentiate complications that might arise due to the limitations of the technique or those that arise from its incorrect application or inappropriate use.

The value of live animal surgery in the laboratory setting, especially for surgeons in the community, should not be underestimated. Although the animal's structures differ somewhat from human anatomy a live surgical situation is important, as it involves many of the same challenges as human surgery. These include contending with respiratory movements and the consequences of poor port placements, poor camera imaging, obscuring of the laparoscope lens, anesthesia complications, bleeding, and death.[14] Until virtual reality and/or surgical simulators reach a certain level of realism (and affordability), the training facility remains the only logical choice to gain skills prior to entering the operating room. STI

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