CHAPTER 16

The Future of Laparoscopic Surgery

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There is no doubt that laparoscopy has opened new frontiers in surgery. It appears that this is only the beginning of a new era, and it is inevitable that we will see drastic changes both in techniques and instrumentation. In closing this book, we touch upon some directions in which we believe laparoscopy is heading.

Within the last five years, laparoscopic cholecystectomy has been accepted as the treatment of choice for the diseased gallbladder. Other procedures, like highly selective vagotomy and fundoplication, are on their way to being accepted. As can be seen from what is written in this book, most abdominal procedures currently can be performed laparoscopically even with instrumentation and equipment that still is imperfect. Projecting into the future, it would be logical to say that we will continue to see technological improvements in our operating rooms.

Optics and imaging systems are an area in which improvement and refinement has been occurring. For example, three-chip camera and image-enhancement systems are already available and provide adequate resolution. Three-dimensional viewing systems are on the horizon. Unfortunately, at this time the resolution of three-dimensional systems is not at an acceptable level.

It is recognized that with laparoscopic surgery the surgeon’s ability to palpate tissues is lost. This disadvantage may be compensated for by the development of a miniaturized, multiple-configuration, or flexible ultrasound probe with three-dimensional imaging, which would allow visualization of normal and abnormal tissues.

Another area in laparoscopy in which evolution will occur is the use of robotics. Currently, robotic “hands” are available that can control the laparoscope with predetermined movements. In the future, these movements will be activated by voice and movements of the surgeon’s instruments and eyes. An example of what the future will bring is found in a
FIG. 16-1. Remotely controlled operation.

prototype of a bone-machining robot used in orthopedic surgery for total hip replacement.\(^1\) It is inevitable that this technology will invade laparoscopic surgery.

Furthermore, the integration of robotics with advanced imaging systems and computers will enable the performance of remote-controlled procedures ("telepresence surgery").\(^2\) In other words, a surgeon will be able to perform a laparoscopic operation from a room separate from the operating suite, even from another city (Fig. 16-1).
A related topic is virtual reality, a technology that allows the participant to interact in a computer-generated three-dimensional environment. Virtual reality surgical simulators are under development. At this stage they are considered to be in a primitive state, but with rapid advancement in computer technology it is expected that surgical simulators will be universally employed in the training of laparoscopic surgeons.

With regard to laparoscopic tools, we expect to see the development of versatile and easy to use laparoscopic staplers. Articulating staplers will simplify the construction of an intestinal anastomosis, and right-angle clip appliers will simplify the ligation of vessels and ducts. The introduction of nontraumatic retractors will reduce the risk of iatrogenic injury to internal organs and will enable better visualization of a target tissue.

In the beginning of laparoscopic surgery, lasers were glamorized. In reality, the current state of laser technology does not confer a real advantage over electrocautery. However, the combination of mechanical and laser action in one instrument ("laser-assisted scalpel") might be an improvement over currently used devices. Tissue ablation by laser will be possible with dye enhancement techniques. Tissue welding with laser and tissue glues will be employed in gastrointestinal and vascular anastomoses.

Cryoablation (cryonecrosis) of liver tumors has been employed in the open approach for the last few years. Soon it will be possible to perform cryoablation of liver tumors via the laparoscope. Laparoscopic cryoablation should lessen the operative trauma on a patient population that is already debilitated.

There is no doubt that surgery will never be the same again. Technology and computer science are invading the operating room. Traditionally, surgeons have not been well versed in these areas. We tend to view computers and "new gadgets" with suspicion, but we must learn to keep an open mind toward these advances in surgery. Our generation has experienced both the open and closed techniques. Currently the favored technique for the majority of abdominal and thoracic procedures is open surgery; this will soon give way to minimally invasive surgery. Tomorrow's surgeons will be the computer-game players of today.

REFERENCES

5. Libutti SK et al: Canine colonic anastomoses reinforced with dye-