The future of robotics: A dilemma for general surgeons

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Many general surgeons are adding robotics to their scope of practice, but most are taking a wait-and-see approach for several reasons. For some surgeons, the technology is simply inaccessible. Others think the currently unfavorable cost/benefit equation makes the expense of adding robotics wasteful, if not ridiculous.

But many physicians are watchfully waiting, seeking more clarity in the face of current uncertainty. Emblematic of these differing perspectives are two recent quotes from noteworthy surgeons: In February 2013, Pier Cristoforo Giulianotti, MD, FACS, chief of minimally invasive, general, and robotic surgery at the University of Illinois at Chicago, said, “In my opinion, there is no way back from robotic surgery.” Meanwhile, in March 2013, James Breeden, MD, FACS, president of the American Congress of Obstetricians and Gynecologists, wrote, “Robotic surgery is not the only or the best minimally invasive approach for hysterectomy.”

It is no wonder that questions and concerns remain: Will robotics enhance the ability of general surgeons to broaden their scope of practice, make the practice of surgery more fulfilling, and add value to the services provided? To address these questions and to assist general surgeons in making decisions about the value of robotic technology for themselves and their patients, this article offers some perspective on what the future may hold. The speculations presented here are based on personal experience and the history of robotic surgery to date. In addition, this article addresses the pathway for safely introducing robotics into practice as it applies to both practicing surgeons and residents in training.

Benefits and challenges

There is considerable evidence that the enthusiasm for robotics is escalating among general surgeons. According to the marketing division of Intuitive Surgical, the company that markets the da Vinci surgical system, general surgeons are among the surgeons most commonly completing the clinical pathway required for credentialing. (Personal communication between Frank Grillo, vice-president, marketing and business development, Intuitive Surgical, Inc., and Dr. Griffen, May 9, 2013.) Now well up in the hundreds, peer-reviewed reports are published with increasing frequency on this topic. The scope of the reports is increasing as well, with virtually every organ and procedure explored for the applicability of robotic technology. To date, the vast majority of the reports that address surgical outcomes reveal that robotically assisted laparoscopy is just as good as, but no better than, laparoscopy alone. In a
meta-analysis of 31 studies that included 2,166 abdominal operations, researchers combed the data for the comparative effectiveness of robotic versus laparoscopic approaches. They concluded that robotics was a developing technology and not yet in a position to immediately replace traditional laparoscopy. They also determined that more studies are required to identify true indications that robotics is superior to other procedures. This begs the question: Is the enthusiasm that surgeons are expressing justified given that increased cost without increased quality or value is unacceptable in today’s health care system?

The robotic technology enthusiast asks a different question: Are we now on the cusp of advances that will gradually revolutionize the practice of general surgery as we gain additional insight and experience? Unquestionably, the technology is phenomenal. Images are three-dimensional, tremor is eliminated, and instruments can be angled intuitively in virtually any direction with seven degrees of freedom, whereas two-dimensional laparoscopy prohibits accurate depth perception, and long laparoscopic instruments increase tremor and provide only four degrees of freedom. Additional advantages of robotics include camera stability that the surgeon controls completely and triangulation of instruments and camera for single-site surgery, which eliminates the obligatory parallax associated with laparoscopy. Regarding parallax, even an experienced laparoscopic surgeon frequently has difficulty fully visualizing the critical view during a single-port laparoscopic cholecystectomy. Robotic technology largely mitigates this limitation. Researchers and clinicians have turned to robotic assistance on many fronts to avoid the deficiencies of laparoscopic technology.

Nonetheless, there is room for improvement. For example, the operating table cannot be repositioned to facilitate procedures once the robotic arms are docked. Also, it remains difficult to work in the multiple quadrants required for some general surgery procedures, such as low anterior resection with take-down of the splenic flexure. Addressing these deficiencies would dramatically enhance robotic utility in general surgery and speed its acceptance. Robotic technology is still in its infancy, and the usefulness of robotics in general surgery likely will be enhanced with new developments. For example, a coagulation/cutting instrument for larger vessels has become available in recent months, and even more recently a robotic vascular and intestinal stapler has been introduced into the marketplace. Balancing utility with safety must continue to guide ongoing advances in robotic technology.

Learning curve for robotics

The learning curve for laparoscopy is long and painstaking. Because of the technical advantages, the learning curve for robotics is much shorter for most surgeons. Researchers have found that suturing was statistically more precise and easier with robotics for residents performing sutured anastomosis on porcine intestine than with laparoscopy. Statistical significance was reached in another study using a live porcine model. Medical students with no experience placed gastro-gastric sutures and tied knots more precisely, faster, and with less operator workload using robotic assistance compared with laparoscopy alone. Marked improvement in the robotically assisted arm was noted with just three repetitions, whereas no improvement in the laparoscopy arm was seen. This finding indicated that the learning curve for robotically assisted suturing and knot tying was shorter.

Tasked with collecting data regarding general surgeons’ acceptance of robotics, a researcher interviewed a young, qualified, but relatively inexperienced surgeon who preferred robotic-assisted to laparoscopic multi-port cholecystectomy. When asked why, according to journalist Deborah Fowler, the student responded, “Because it is
For multi-port cholecystectomy performed by a seasoned laparoscopic surgeon, it is almost impossible to envision any way to improve any outcome measure. In essence, for multi-port cholecystectomy, robotics decreases the value of care by increasing costs without improving quality. However, the progression from easier to more precise to safer cannot be so easily dismissed when considering the performance of procedures that are more technically demanding. As surgeons progress through the learning curve and become increasingly skilled in robotics, it is logical to theorize that ease and precision will lead to better outcomes. It is also likely that the scope of minimally invasive surgery will broaden to include more complex procedures. This trend is exemplified by the performance of robotic prostatectomy, which is now widespread. It has become the surgical option of choice, whereas many urologists found laparoscopic prostatectomy so challenging that few had the capability to safely pursue it.

The future of robotic surgery can be determined only by probing the possibilities. To ignore the potential for extending the boundaries and safety of surgical care with robotic technology seems unwise. As a paradigm, there were many naysayers during the advent of laparoscopic surgery; time has proven them wrong.

### Policies and standards

L. D. Britt, MD, MPH, FACS, a Past-President of the American College of Surgeons (ACS), plays a leadership role in numerous organizations that set the policies for general surgery training. According to Dr. Britt, “While our discipline needs to continue ‘to push the edge of the envelope’ with respect to embracing advanced technology, it is equally imperative that any innovation (including robotic surgery) has a documented proven benefit based on evidence/outcome analysis. As the stewards of our resources, we must also promote cost effectiveness.” (Personal communication with Dr. Griffen, January 2013.) These requirements are clearly stated in an ACS Committee on Emerging Surgical Technologies and Education (CESTE) policy dating back to 1995 titled Statement on Issues to be Considered Before New Surgical Technology Is Applied to the Care of Patients. Dr. Britt points out that although the College’s leaders are supportive of pursuing robotic technology, they are concerned that, thus far, little data are available to justify it. Even so, there is some optimism that important applications for robotics will evolve that will expand the scope of general surgery beyond current boundaries. At this time, developing final policy regarding these issues is premature.

### Training and credentialing

Several reports address robotic surgery and resident training. In preparation for participating in robotic cases at the surgeon’s console, residents should be required to spend a specified amount of time in a robotic simulator and achieve a defined degree of proficiency. Also, residents should complete the surgeon’s didactic training modules on the Intuitive Surgical website. At Louisiana State University Medical Center (LSUHealth), Shreveport, the senior author requires residents to spend a minimum of four hours in a robotic simulator and successfully complete the Web-based didactic course. Residents then must attain experience and proficiency with the patient console. Then, they may participate in the tandem surgeon’s console and begin their proctored/mentored operative experience dissecting first a non-inflamed gallbladder from its fossa. From there, residents are allowed to progress at varying rates depending on their abilities. Ideally, residents and attending surgeons should have access to dual (tandem) surgeon’s consoles,
making it easy to safely share surgeons’ responsibilities. Residents who are unable to competently operate using the dual consoles will have their training in robotics slowed to ensure patient safety.\textsuperscript{13,14}

The requirements for acquiring credentials in robotic surgery after completion of residency have varied among hospitals.\textsuperscript{15} CESTE has promulgated clear guidelines in the ACS Statement on Emerging Surgical Technologies and the Evaluation of Credentials, and surgeons in active practice and newly trained surgeons should strictly follow the guidelines set forth in this statement.\textsuperscript{16} Certainly, residents will be required to document their training and experience with a letter of acknowledgment from the chair of their department. With this requirement in mind, residents are encouraged to log their robot-assisted cases separately; otherwise, they will be hard to find later given that robotic-assisted and purely laparoscopic cases currently share the same codes. Temporary privileges with proctoring prior to becoming fully credentialed must follow. For those surgeons who completed their residencies before the robotic era, a credentialing pathway is available and should be followed in every instance. This pathway meets the criteria that the CESTE set in its Statement on Approval of Courses in New Skills.\textsuperscript{17} This training includes Web-based didactics, simulation, a pig lab with assessment of knowledge and skill, and temporary privileges and proctoring. Successful completion of these requirements leads to full privileges.

Introducing a new technology into a surgeon’s repertoire also requires choosing easier cases performed on ideal patients. Even though the cost/quality equation for value appears unfavorable, this is likely the place for robotically assisted multi-port cholecystectomy for surgeons in private practice, academics, and residency.\textsuperscript{18} Serving as a bridge toward skills needed for more complex procedures, multi-port cholecystectomy may be justifiable on a cost/value basis after all.

Even though robotics makes it easier to perform technical tasks, the safe application of the other aspects of the technology is daunting. Beyond the basic requirements for credentials, the complexity that robots bring to the operating room environment is unparalleled. These complexities compel a significant moral and professional commitment to put safety first. An article in the August 2010 \textit{Bulletin of the American College of Surgeons} clarifies the surgeon’s obligation to make the environment safe.\textsuperscript{19} In a different report written years before robotics became more commonly used in surgery, many of the same points are made in a generic sense, with added emphasis on team training by surgeons, institutions, and device manufacturers.\textsuperscript{20} The complex robotic environment maximizes the importance of the team concept. Only with diligent attention to all of these issues that take surgeons beyond the relative security of the user-friendly surgeons’ console will the benefits of robotically assisted laparoscopy be safely realized.

The dilemma

For some general surgeons, making the decision to pursue robotics is difficult, and the decision may vary with the nature of each surgeon’s practice. For surgeons that embraced laparoscopy belatedly, the consequences were sometimes damaging. Given the much shorter learning curve, a wait-and-see approach to robotic training should have fewer adverse effects. However, several factors are influencing the early pursuit of robotics, including:

- Many surgeons have already trained in robotics and are probing the possibilities.
- Hospitals are marketing robotics as evidence that they are state-of-the-art facilities.
Residents trained in robotics are applying for robotics credentials in gradually increasing numbers. The number of surgeons in the training pipeline is increasing. As of December 2012, financial analysts are advising investors to buy/hold stock in Intuitive Surgical, concluding that the need for additional robots will be ongoing as more surgeons enter this territory.\(^{21}\)

Many of the wait-and-see general surgeons are thinking that the added cost for robotically assisted laparoscopy will forestall a robotic era and mitigate the need to pursue robotics. Thus far, payors are only monitoring the situation; for the most part, they pay surgeons and facilities the same for procedures, with little concern for the methods used. For example, the Current Procedural Terminology (CPT) billing code for robotically assisted laparoscopic cholecystectomy is the same as that for laparoscopic cholecystectomy without robotic assistance (CPT code 47562).\(^{22}\) Hospitals continue to absorb extra cost, hoping to offset it with the presumed advantage it affords for market share. It is questionable whether this policy will continue as volume swells with general surgery cases.

In this era of health care reform and limited funding, robotics in surgery is correctly under intense scrutiny. Thus far, the cost/quality equation for value often has been at odds with additional investment of the health care dollar in robotic technology. The apparent waste incurred pursuing a flight to the moon led to a giant step forward in technology that proved to be of tremendous value in other areas. Is this a paradigm for robotic surgery, thus justifying the cost, expecting benefits with experience over time? Surgeons must contribute meaningfully to the debate, helping to guide industry, government, and payors in a path that best serves the safe, efficient, value-based care of their patients.

General surgeons not yet committed to robotics should stay well-informed with regard to this technology so as to make good career choices. The scope of surgical practice varies. As such, some surgeons are likely to find robotically assisted laparoscopy to be an important part of their practice, while others will not. For example, a young surgeon practicing in a small rural hospital without robotic capability can, with good reason, opt to hone laparoscopic skills and await further developments. On the other hand, a skilled, advanced laparoscopist working in a larger facility with robotic capabilities already in place should seriously consider the alternative approach. From the authors’ perspective, those surgeons who are in a position to embrace robotic training will find increasing meaningful use for the technology, which will enhance the value of the care they provide and the scope of practice they enjoy.

References


*Tagged as:* ACS Committee on Emerging Surgical Technology and Education, Intuitive Surgical, Louisiana State University Medical Center, robotic surgery, robotic surgical education, robotic technology

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