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Review Article

Role of Robotics in Laparoscopic Surgery: Review

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Abstract

No matter what type of surgery you choose, you can rest assured that you are in the hands of the most experienced and skilled doctors because laparoscopic or robotics both are operated by a surgeon only. Most patients and physicians would agree that minimally invasive surgery is preferred over traditional open surgery techniques. However, sometimes patients have the choice between two minimally invasive surgery techniques: robotic surgery and laparoscopic surgery. Most surgeons and patients would agree: minimally-invasive surgery is preferable to open surgery. There's often less post-operative pain, hospital stays are shorter and recovery is easier. Only you and your doctor can decide which is best in your case. But we need to be through on to learn the basics and what to expect with both methods. This review explains about connection in laparoscopic and robotic surgery.

Keywords: Laparoscopy, Robotics, Comparison, Surgery.

INTRODUCTION

With traditional "open" surgery, surgeon uses one large incision to perform a procedure. With laparoscopic surgery, the surgeon makes several small incisions and inserts small tools – including a video camera – to perform the procedure. The video images are displayed on a monitor and the surgeon watches the screen to move the tools and do his or her work. The advantages of laparoscopic surgery – and, really, any minimally-invasive option – are mostly related to having small incisions rather than one large one: there's less blood loss, less pain and less noticeable scars. There are also economic benefits: a shorter hospital stay generally means lower medical costs, and a faster recovery means you can get back to work sooner [1]. Laparoscopic surgery does have some limitations, however: the video images associated with it are two dimensional. And the tools can have a limited range of motion – up and down and side to side – which can make it tricky to work in tight spaces. On the flip side, laparoscopic surgeons are able to use the familiar sensations of pressure and other tactile movements to manipulate the tools. Robotic surgery is similar to a laparoscopic procedure in many respects: the surgeon makes several small incisions and uses a video camera and instruments to guide his or her work [2]. The difference with robotic surgery is that the surgeon sits at a computer and uses hand controls to manipulate the robot – rather than holding and manipulating the tools themselves, as with laparoscopic surgery. And the imagery is three-dimensional, high definition and magnified – all of which allow for better vision and greater precision. The other distinguishing factor is that the instruments used for robotic surgery are "wristed" – they move like a hand [3]. This provides greater range of motion and more precision, which can mean less manipulation of tissues, less bleeding and less post-operative pain than with laparoscopic surgery. Most hospitals have at least one robotic surgical machine. Many surgeons believe robotic surgery is advantageous for surgeries in small spaces like the head and neck, with extremely obese patients where hands-on surgery can be difficult and for gynecologic and urologic surgeries. According to the National Cancer Institute, nearly 80 percent of prostate removal surgeries are now done with robotic surgery [4].

Robotic and laproscopy

Short recovery– As with any laparoscopic procedure, robotic surgery usually leads to a quicker recovery and less post-operative pain compared to open-incision surgery [5]. True 3D view– The thin

telescope inserted into the patient's body actually contains two lenses, each served by a separate camera. At the control console, Scott D. Miller, MD views a slightly different image with each eye, giving him a true 3D image. This ability allows smoother instrument movements and better appreciation of subtle tissue characteristics. Increased surgeon control– With laparoscopic surgery, each hand controls one instrument or the camera (a total of two items). With robotic surgery, Dr. Scott Miller controls all camera movements and three instruments (four items). "Scaling" of movement – The robotic instruments move proportionately smaller distances in the body than the hand controls move at the surgeon's control console [6]. This added precision is particularly useful with the system's magnified view. The robotic tools are doing very precise incisions. Laparoscopic instruments only have four degrees of freedom whereas the da Vinci Endowrist instruments have seven degrees of freedom, which allow for a greater range of precise motion. The robotic arms are perfectly mirroring the human hand's movements in real-time filtering out hand tremors reducing the surgical errors. The two different cameras are using two different angles, one is straight and the other is 30-degree oblique offering visibility around corners. Better visibility also means better identification of the problem. The more we identify the more we treat. From the system console the surgeon can manipulate the lighting where is needed through the robotic arms. Standard laparoscopic surgery uses one camera and provides a 2D view [7]. The da Vinci robotic camera uses two high-resolution fiber optic cameras with 3D color picture and 10x magnification. The laparoscopic and robotic instruments look very similar at first sight but you need to know that the robotic instruments have the advantage of being articulated so the instruments are not only open and close but turn and twist Rather than using a large incision, laparoscopy involves using several small incisions to perform a surgical procedure. Robotic surgery is a laparoscopic procedure, only with an added layer of technology [8]. As with other laparoscopic procedures, the surgeon makes a button-size incision in the abdominal cavity for the insertion of a telescope. After expanding the abdominal cavity with carbon dioxide gas, three additional small incisions are made to place narrow tubes used for interchangeable instruments. Instead of the surgeon's hands directly moving the instruments, the robotic device is wheeled up to the patient and the robotic arms are attached to the telescope and the instruments. The surgeon then sits at the control console a few feet from the patient, leaving the surgical assistant and scrub nurse at the patient's side. One or two additional small tubes are often placed for the surgical assistant to use. The surgeon then views a highly magnified, three-dimensional image of the patient's interior structures. All movements of the camera and robotic instruments are precisely performed in real-time by the surgeon using ergonomic finger controls. The tips of these instruments can make any wrist-like turn that the surgeon so desires [9]. The procedure is performed using instruments such as miniature tweezers and scissors the size of a fingernail (although these scissors appear to be the size of hedge clippers to the surgeon observing them via video).

	Robotic Surgery	Laparoscopic Surgery
Incision	Tiny incisions	Tiny incisions
Surgical instruments	• Camera • Small instrument • Surgeon's console • Endowrist instruments	• Camera • Small instrument
Where your surgeon stands	At the console	Next to you
How surgery is performed	Surgeon directs the robot's movements from the console; the robotic instruments in your body respond in real-time	Surgeon operates using the instruments previously inserted in the incisions
Level of dexterity	Highest possible; robotic instruments can rotate a full 360 degrees and are more flexible than a human hand or wrist	Limited range of motion compared to robotic
Ability to access hard-to-reach places	Incomparable; the robot has the dexterity to reach previously inaccessible areas of the body	Greater compared to traditional open surgery due to smaller instruments; less than compared to robotic surgery
Recovery time	Shorter compared to traditional surgery	Shorter compared to traditional surgery
Risk of infection and blood loss	Rare	Rare

DISCUSSION

New technology (laparoscopes, clip appliers, and energy sources) enabled the laparoscopic revolution of the early 1990s. Today, however, the technology that fueled the laparoscopic revolution is aged and hinders further advances in the field. The term "Robot" was first used in Capek's 1920 play Rossum's Universal

Robots and is derived from the Czechoslovakian word robata, meaning "forced labor" [10]. Several robot devices are now available to manipulate the laparoscope, replacing the camera operator. AESOP (Automated Endoscopic System for Optimal Positioning) (Computer Motion Inc, Goleta, CA) recognizes voice commands. The system abolishes the need for a surgical assistant and provides stability of view, and the depiction of the operative field is under the direct control of the surgeon. Savings occur in both time and human personal required to performed the procedure [11]. Hermes (Computer Motion) is a voice-activated system that recognized spoken commands to adjust the lighting in the operating room, adjust the operating table, contact another physician, or gather information on the Internet. A wealth of information and databases thus can be made available to the surgeon during the procedure to improve patient care. The Zeus, also from Computer Motion, is a remote-controlled robot that can perform surgical interventions. This device incorporates three interactive arms: one voice-activated arm to control the laparoscope and two robotic arms to manipulate instruments, which are controlled with joysticks at the surgeon's workstation. This system filters the natural tremor present in a human hand and provides greater control of the surgical instruments [12]. This device is not yet FDA-approved. The Da Vinci Surgical System (Intuitive Surgical, Mount View, CA) combines robotics and computer imaging to enable microsurgery in a laparoscopic environment. The system consists of a surgeon's viewing and control console integrated with a high-performance 3D monitor system and a patient side cart consisting of three robotic arms [13]. In a study surgeon have used the Da Vinci for 34 advanced laparoscopic cases: 7 gastric bypasses for morbid obesity, 9 Heller myotomies for achalasia, 11 donor nephrectomies, 2 gastrojejunostomies, and single cases of bilateral adrenalectomy, Nissen fundoplication, Toupet fundoplication, and cholecystectomy. No robot-related complications were noted in their study [14].

Conclusion

When all influence factors are taken into account, robotic surgery need not necessarily be more expensive than open and laparoscopic surgery. Even for demanding visceral surgery procedures, the perioperative complication rate for robotic surgery is not higher than for open or laparoscopic surgical procedures. In cancer cases, the oncological accuracy of robotic resection for gastric, pancreatic, and rectal resection is seen to be adequate. Only the operating time is generally longer than for standard laparoscopic and open procedures. But, on the other hand, in some procedures blood loss is less, conversion rates are lower, and hospital stay shorter. This early experience suggests that robotic surgery is a safe and effective alternative to conventional laparoscopic surgery. We believe that robotic surgery, with its ability to restore the hand–eye coordination and three-dimensional view lost in laparoscopic surgery, will allow us to perform complex procedures with greater precision and confidence and better results.

References

1. Marano, A., Choi, Y. Y., Hyung, W. J., Kim, Y. M., Kim, J., & Noh, S. H. (2013). Robotic versus laparoscopic versus open gastrectomy: a meta-analysis. *Journal of gastric cancer*, *13*(3), 136-148.
2. Hyun, M. H., Lee, C. H., Kim, H. J., Tong, Y., & Park, S. S. (2013). Systematic review and meta-analysis of robotic surgery compared with conventional laparoscopic and open resections for gastric carcinoma. *British Journal of Surgery*, *100*(12), 1566-1578.
3. Sackier, J. M., & Wang, Y. (1994). Robotically assisted laparoscopic surgery. *Surgical endoscopy*, *8*(1), 63-66.
4. Kavic, M. S. (2000). Robotics, technology, and the future of surgery. *JSLS: Journal of the Society of Laparoendoscopic Surgeons*, *4*(4), 277.
5. Schneider, I. (2000). Robotic tool enhances laparoscopic procedures. *Medical Laser Report*, *14*, 5-6.
6. Mack, M. J. (2001). Minimally invasive and robotic surgery. *Jama*, *285*(5), 568-572.
7. Gill, I. S., Sung, G. T., Hsu, T. H., & Meraney, A. M. (2000). Robotic Remote Laparoscopic Nephrectomy and Adrenalectomy: The Initial Experience. *The Journal of urology*, *164*(6), 2082-2085.
8. Piazza, L., Caragliano, P., Scardilli, M., Sgroi, A. V., Marino, G., & Giannone, G. (1999). Laparoscopic robot-assisted right adrenalectomy and left ovariectomy. *Chirurgia italiana*, *51*(6), 465-466.
9. Schurr, M. O., Arezzo, A., & Buess, G. F. (1999). Robotics and systems technology for advanced endoscopic procedures: experiences in general surgery. *European Journal of Cardio-Thoracic Surgery*, *16*(Supplement_2), S97-S105.
10. Giulianotti, P. C., Coratti, A., Angelini, M., Sbrana, F., Cecconi, S., Balestracci, T., & Caravaglios, G. (2003). Robotics in general surgery: personal experience in a large community hospital. *Archives of surgery*, *138*(7), 777-784.
11. Falk, V., Diegler, A., Walther, T., Autschbach, R., & Mohr, F. W. (2000). Developments in robotic cardiac surgery. *Current opinion in cardiology*, *15*(6), 378-387.
12. Degueldre, M., Vandromme, J., Huong, P. T., & Cadière, G. B. (2000). Robotically assisted laparoscopic microsurgical tubal reanastomosis: a feasibility study. *Fertility and sterility*, *74*(5), 1020-1023.
13. Aggarwal, R., Darzi, A., & Yang, G. Z. (2010). Robotics in surgery–past, present and future. *Med Sci*, *2*.

14. Horgan, S., & Vanuno, D. (2001). Robots in laparoscopic surgery. *Journal of Laparoendoscopic & Advanced Surgical Techniques*, *11*(6), 415-419.