**Improving Patient Outcomes in Laparoscopic Colorectal Surgery: Preventing Adverse Events and Mastering Tissue Management**

**Background**

The first laparoscopic colon resection was performed in 1991. Although considered to be an advance over open surgery, laparoscopic technology was not widely adopted by the general or colorectal surgical community for a variety of reasons, including the increased complexity and technical difficulty of the surgeries and fears that the outcome in cancer patients would be worse.

Today, more laparoscopic resections are being done as data supporting its safety and equivalence to open surgery, in regard to cancer outcome, are published. To date, at least 6 large (ie, ≥100 patients) prospective, randomized trials have shown no significant detrimental impact on recurrence or survival when comparing laparoscopic with open surgery for the treatment of colon cancer. Two randomized meta-analyses also concluded that laparoscopic surgery for cancer is associated with outcomes comparable with those associated with open surgery.

The optimal selection of devices used in laparoscopic surgery, including surgical staplers and staple cartridges, as well as an understanding of the interactions between the surgeon, tissue, and the device are fundamental points of knowledge for surgeons. Possessing this information allows general and colorectal surgeons to maximize the patient benefits associated with bowel stapling techniques.

**Improved Outcomes With Laparoscopic Surgery and Stapler Technology**

Laparoscopic colorectal resections take more time to complete than the equivalent open colorectal procedure; however, the procedure is associated with shorter intensive care unit and hospital stays, decreased use of analgesics, a more rapid return of bowel function, and resumption of oral intake. Some investigators also have reported a lower rate of anastomotic leaks with stapled anastomoses.

“The literature suggests that leaks continue to develop in both colonic and rectal anastomoses,” said Richard L. Whelan, MD, chief of the Colon and Rectal Surgery Service at St. Luke’s-Roosevelt Hospital, and professor of surgery, Columbia University College of Physicians and Surgeons, New York City. Leaks are associated with reduced short- and long-term disease-free survival following colorectal cancer surgery.

**Minimizing Leaks and Managing Tissue Compression**

Although most studies show similar leak rates for stapled and hand-sewn anastomotic techniques, a recent systematic review of 6 randomized trials comparing stapling (n=357) with hand suturing (n=598) in 955 patients with right-sided bowel cancer or Crohn’s disease found that the anastomotic leak rate for stapled anastomosis overall was 1.4%, which was significantly lower than the rate noted for the hand–sew group (6%). Other potential advantages of anastomotic stapling methods include more consistent results and reduced operative time.

Tissue compression—which must be adequate yet not excessive in order to form a strong staple line—is determined by and is a function of the thickness of the tissue being stapled. Ethicon Endo-Surgery (EES) Intraluminal Staplers have an adjustable staple height (Figure 1), whereas the EEA™ Circular Staplers offer several different fixed staple heights in order to accommodate varying tissue thicknesses. Using EES Intraluminal Staplers, the surgeon selects, by feel, the degree to which the staple is closed and the bowel compressed; this compression then determines closed staple height, which is verified by the device indicator. Even electrosurgical tools, such as EES ENSEAL® devices that use an electric current to heat and seal tissue for anastomosis, require adequate compression for proper functioning and a secure seal.

For optimal functioning, after closing the stapler, the surgeon must wait an adequate length of time so that some of the fluid in the bowel wall can shift away from the area being stapled. If the bowel ends are compressed too tightly, one or both sections being joined may tear. It is recommended that surgeons compress the tissue for 15 seconds and confirm device indicator in firing range after closing the stapler prior to firing the device. This procedure should result in a strong staple line even for thick tissue.

Best use of the range of staple sizes available promotes hemostasis and tissue apposition while also avoiding ischemic tissue destruction. For example, EES manufactures 5 different types of staple cartridges for endoscopic stapling (Figure 2). Green cartridge staples have the largest gap size (2 mm staple height when closed) and are best suited for use in thick tissue (Figure 3). Gray cartridge staples...
are the smallest with a 0.85 mm closed staple height and are best used on thin tissue. A formed staple height that is too tall may result in an inadequate seal and bleeding.

**Stapler Technical Error, Surgeon Experience, and Patient-Related Factors**

Every device has a failure rate associated with its use. However, the failure rate of any given device is affected by the location of the surgery, the technical difficulty of the location, and the experience of the surgeon, as well as the inherent device failure rate.

Offodile and colleagues conducted an investigation of their single-center experience using a circular stapler in 349 colorectal resections. The study authors found 67 technical errors (19% or 1 in 5 cases). Technical error was described as any deviation from the normal technical performance of the circular stapler, including but not limited to surgeon misfiring, incomplete anastomosis, and primary device failure. The authors hypothesized that causes of the 19% technical error rate included a high use of surgical residents who had limited knowledge regarding proper and reliable device deployment. They also concluded that awareness of increased resistance or an abnormal feel while closing the stapler is only acquired after considerable experience.

Other potential causes of stapler problems included various preexisting patient conditions and a history of preoperative radiation. Radiation therapy has been shown to promote alterations (both vascular and epithelial) in the impacted tissue (eg, loss of volume in the capillary bed and alterations in mucosal tissue). These alterations may result in changes in tissue thickness that, in turn, would cause tissue to diverge from the thickness range of the staple being used. Also, acute inflammation and bowel obstruction result in appreciable bowel thickening. Other patient-associated conditions that may cause failure include chronic use of steroids and poor nutritional status. These factors underscore the importance of surgeon training and, as Dr. Whelan stressed, “surgeon retraining.”

**Figure 3.** Open and closed staple heights for blue and green cartridges.

Image courtesy of Ethicon Endo-Surgery.

**References**