Minimally Invasive Colorectal Surgery: A Team Approach

(A Continuing Education Self-Study Activity)

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MINIMALLY INVASIVE COLORECTAL SURGERY: A TEAM APPROACH

(A Continuing Education Self-Study Activity)

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2101 S. Blackhawk Street, Suite 220
Aurora, CO 80014-1475
Phone: 720-748-6144
Fax: 720-748-6196
Website: www.pfiedlerenterprises.com

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OVERVIEW

Colorectal cancer is one of the most prevalent malignancies in the US today; the diagnosis of colorectal cancer is often quite challenging, as concerns about both the treatment and disease recurrence can cause significant anxiety for the patient and his/her family. In most cases of colorectal cancer, surgery is the primary treatment option. Today, as technological advancements in the practice of surgery continue, minimally invasive approaches to colorectal surgery offer patients with colorectal cancer promising new treatment options. It is imperative that not only the surgeon, but all members of the perioperative team, are knowledgeable about and experienced in minimally invasive surgical techniques, as the team approach is vital to promoting positive patient outcomes. The purpose of this continuing education activity is to provide an overview of minimally invasive colorectal surgery and the importance of the team approach. It will provide a review of colorectal cancer including its incidence, diagnosis, treatment options, and key patient considerations in selecting the minimally invasive surgical approach. Two minimally invasive surgical approaches also will be presented, including a discussion of various energy modalities. The role of the specialty team, along with patient care considerations, will be explored.

OBJECTIVES

After completing this continuing nursing education activity, the learner should be able to:

1. Discuss the incidence of colorectal cancer in the US today.
2. Identify patient considerations in minimally invasive colorectal surgery.
3. Explain various minimally invasive surgical approaches for colorectal cancer.
4. Describe the role of the specialty team in minimally invasive colorectal surgery.

INTENDED AUDIENCE

This continuing education activity is intended for perioperative registered nurses and other healthcare professionals that are involved as members of the specialty team caring for patients having colorectal surgery.

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PLANNING COMMITTEE

Judith I. Pfister, RN, BSN, MBA
Program Manager
Pfiedler Enterprises
Aurora, CO

Rose Moss, RN, MN, CNOR
Nurse Consultant
Del Norte, CO

EXPERT REVIEWER

Julia A. Kneedler, RN, EdD
Director of Education
Pfiedler Enterprises
Aurora, CO

AST REVIEWER

Penny Austin, CST
Surgical Technologist
Aurora Medical Center
Aurora, Colorado

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Judith I. Pfister, RN, BSN, MBA

1. No
2. Not Applicable
3. No

Rose Moss, RN, MN, CNOR

1. No
2. Not Applicable
3. No

Julia A. Kneedler, RN, MS, EdD

1. No
2. Not Applicable
3. No

Penny Austin, CST

1. No
2. Not Applicable
3. No

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Phone:	720-748-6144
Email:	tonia@pfiedlerenterprises.com
Postal Address:	2101 S. Blackhawk Street, Suite 220 Aurora, Colorado 80014
Website URL:	http://www.pfiedlerenterprises.com

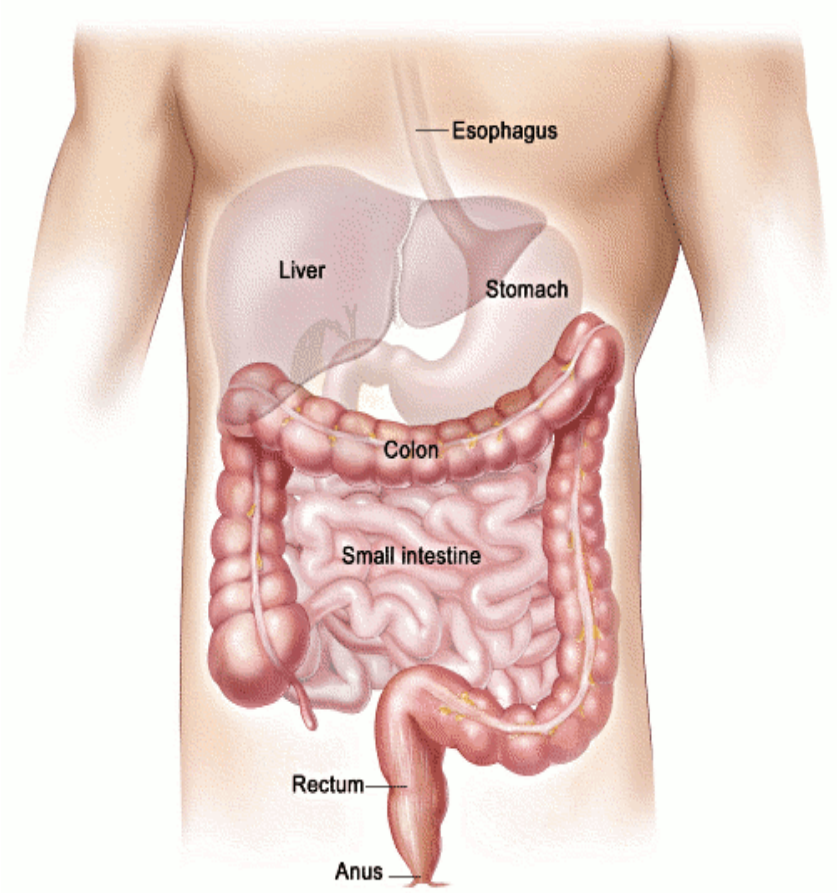
I. COLORECTAL CANCER: INTRODUCTION AND OVERVIEW

Definition

Cancers of the colon and rectum are defined as follows:[1]

- Colon cancer - Cancer that forms in the tissues of the colon, i.e., the longest part of the large intestine (see Figure 1). Most colon cancers are adenocarcinomas.
- Rectal cancer - Cancer that forms in the tissues of the rectum, i.e., the last several inches of the large intestine closest to the anus (see Figure 1).

Figure 1 – Gastrointestinal System



Incidence/Deaths

Colorectal cancer is the third most common form of cancer and the third leading cause of death in both men and women in the US. It is estimated that 148,810 new cases of colorectal cancer (108,070 cases of colon cancer [72%]; 40,740 cases of rectal cancer [28%]) and 49,960 deaths were expected to occur in 2008, accounting for 9% of all cancer deaths.[2, 3]

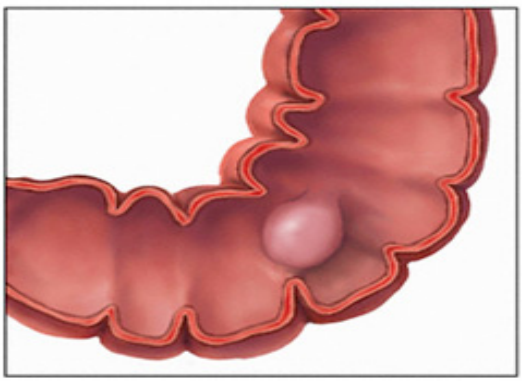
The incidence of colorectal cancer has been decreasing over the last two decades (from 66.3 cases per 100,000 population in 1985 to 48.2 in 2004), with a more steep decline seen in the most recent time frame (2.3% per year from 1998 to 2004). This decline is due in part to an increase in screening, which often results in the detection and removal of colorectal polyps before they progress to cancer.[4]

Signs and Symptoms[5]

The patient with early stage colorectal cancer often is asymptomatic; therefore, screening is important in order to detect the disease as early as possible. Most colorectal cancers begin as a polyp, a small growth in the colon wall (see Figure 2). Over time, polyps grow and may become malignant; as they grow, they can bleed and obstruct the colon. Individuals with the following signs and symptoms should seek medical evaluation:

- Rectal bleeding;
- Blood in the stool or in the toilet after a bowel movement;
- A change in the shape of the stool;
- Cramping pain in the lower stomach;
- A feeling of discomfort, or an urge to have a bowel movement when there is no need to have one;
- New onset of constipation; and
- Abnormal weight loss.

Figure 2 – Colon Polyp



Risk Factors[6]

Anyone can develop colon cancer: in the US, the lifetime risk of being diagnosed with cancer of the colon or rectum is 5.5% for men and 5.1% for women; 20-25% of cases occur in individuals with a family history of colorectal cancer or a predisposing illness. Other risk factors include:

- Age – both the incidence and death rates for colorectal cancer increase with age; in general, 91% of new cases and 94% of deaths occur in patients 50 years of age and older. In addition, the incidence of colorectal cancer is over 14 times higher in adults 50 years of age and older than those under 50 years of age.
- Sex – colorectal incidence and mortality rates are 35% higher in men than women. While the reasons for the higher risk in men are not completely understood, it is thought that they may reflect higher frequencies of abdominal obesity, smoking, and drinking in men, as well as hormonal differences.
- Race/ethnicity – the incidence and mortality rates for colorectal cancer are highest in African American men and women; among African Americans, the incidence rates are over 20% higher and mortality rates about 45% higher than those in whites.

Screening/Diagnosis

Early diagnosis of colon cancer depends upon routine screening; the tests used to screen for and diagnose colon cancer include the following:[7,8]

- Fecal occult blood testing - This test is performed annually since fecal occult blood is an early sign of colon cancer. To facilitate accurate test results, the patient is instructed to eat a high-fiber diet that is free of red meat for 3 days before providing the stool sample; alternatively, stool obtained during a digital rectal examination by a physician can be tested. If blood is detected, further testing is needed.
- Flexible sigmoidoscopy – This is another diagnostic procedure performed for colorectal cancer screening. The rectum and sigmoid colon are examined via endoscopy. Pre-procedure, the patient performs simple bowel cleansing, usually with enemas, to prepare the colon for the exam. If polyps or tumors are found, the patient is referred for colonoscopy.
- Colonoscopy – As noted above, patients in whom polyps or tumors have been discovered on sigmoidoscopy, or people at high risk, may undergo colonoscopy, during which the entire large intestine is evaluated and polyps are removed. Patients are instructed to take special laxatives to completely cleanse the colon prior to the procedure. Some patients with increased risk of colorectal cancer due to family history or other medical conditions should begin colorectal cancer screening before age 50; colonoscopy is the only recommended screening method for patients at high risk.

- Computed tomography colonography (CTC) - This test, also know as virtual colonoscopy, generates three-dimensional images of the colon by using a special CT scan technique that results in detailed, cross-sectional, 2- or 3-dimensional views of the entire colon and rectum. In this procedure, a small, flexible tube is inserted into the rectum to inflate the colon with air or carbon dioxide; the patient then passes through the CT scanner, which creates multiple images of the interior of the colon. This procedure may be an option for patients who are unable or unwilling to undergo the standard colonoscopy procedure, but it is less sensitive and highly interpreter-dependent. CTC still requires a thorough bowel preparation, and the gas may be uncomfortable. Patients with polyps or other abnormal results are referred for colonoscopy.

At the time of cancer diagnosis, staging describes the extent of the disease; staging is essential in order to determine the course of treatment and assess the patient's prognosis.[9] The stage of the cancer is based primarily on the primary tumor's size and location, and whether it has metastasized to other areas of the body. One of the most commonly used staging systems is the TNM system, which assesses tumors in three ways (see Table 1):

- T = tumor – extent of the primary tumor.
- N = nodes – presence or absence of regional lymph node involvement.
- M = metastasis – presence or absence of distal metastases.

A number is added to each letter to indicate the size or extent of the tumor and the extent of spread.

Table 1 – TNM Staging Classification[10]

Primary Tumor (T)	Regional Lymph Nodes (N)	Distant Metastasis (M)
TX: Primary tumor cannot be evaluated	NX: Regional lymph nodes cannot be evaluated	MS: Distant metastasis cannot be evaluated
T0: No evidence of primary tumor	N0: No regional lymph node involvement (no cancer detected in the lymph nodes)	M0: No distant metastasis (cancer had not spread to other parts of the body)
Tis: Carcinoma in situ (early cancer that has not spread to adjacent tissues)	N1, N2, N3: Involvement of regional lymph nodes (number and/or extent of spread)	M1: Distant metastasis (cancer has spread to distant parts of the body)
T1, T2, T3, T4: Size and/or extent of primary tumor		

Once these factors have been determined, a stage of I, II, III, or IV is assigned (see Table 2).

Table 2 – Stages of Colon Cancer[11]

Stage 0 (Carcinoma in Situ)	In stage 0, abnormal cells are found in the innermost lining of the colon. These abnormal cells may become cancer and spread into nearby normal tissue.
Stage I	In stage I, cancer has formed and spread beyond the innermost tissue layer of the colon wall to the middle layers. Stage I colon cancer is sometimes called Dukes A colon cancer.
Stage II	Stage II colon cancer is divided into stage IIA and stage IIB. • Stage IIA: Cancer has spread beyond the middle tissue layers of the colon wall or has spread to nearby tissues around the colon or rectum. • Stage IIB: Cancer has spread beyond the colon wall into nearby organs and/or through the peritoneum. Stage II colon cancer is sometimes called Dukes B colon cancer.
Stage III	Stage III colon cancer is divided into stage IIIA, stage IIIB, and stage IIIC. • Stage IIIA: Cancer has spread from the innermost tissue layer of the colon wall to the middle layers and has spread to as many as three nearby lymph nodes. • Stage IIIB: Cancer has spread to as many as 3 nearby lymph nodes and has spread: o beyond the middle tissue layers of the colon wall; or o to nearby tissues around the colon or rectum; or o beyond the colon wall into nearby organs and/or through the peritoneum. • Stage IIIC: Cancer has spread to 4 or more nearby lymph nodes and has spread: o to or beyond the middle tissue layers of the colon wall; or o to nearby tissues around the colon or rectum; or o to nearby organs and/or through the peritoneum. Stage III colon cancer is sometimes called Dukes C colon cancer.

Stage IV	In stage IV, cancer may have spread to nearby lymph nodes and has spread to other parts of the body, such as the liver or lungs. Stage IV colon cancer is sometimes called Dukes D colon cancer.

Treatment

The majority of patients diagnosed with colorectal cancer will undergo surgery. For established cases of colorectal cancer, the three main types of treatment are:

- Surgical - colectomy to remove the segment of the bowel containing the malignant tumor;
- Radiation therapy; and
- Chemotherapy.

Depending on the stage of the cancer, two or more of these treatment options may be combined.

II. MINIMALLY INVASIVE COLORECTAL SURGERY

Introduction

As advancements in minimally invasive colorectal surgery continue to progress, and surgeons perform these procedures with greater frequency, minimally invasive techniques provide exciting new therapeutic treatment options for patients. Minimally invasive colorectal surgery is better tolerated in comparison to open surgery. The patients whose surgeries are completed by these minimally invasive techniques experience a quicker recovery, less pain and a faster return to their activities of daily living. This portion of the study guide will focus on two minimally invasive approaches for colorectal surgery: laparoscopic-assisted colectomy and hand-assisted laparoscopic colectomy and their related clinical considerations.

Patient Considerations/Selection Criteria for Minimally Invasive Surgical Approach[12]

Laparoscopic surgery has advanced in the last few years with new and improved instrumentation and surgical approaches. Initially minimally invasive colorectal surgery was introduced and used for patients only with benign diseases. Recent studies have indicated that minimally invasive approaches have proven effective for treating malignant disease as well. Therefore selection criteria used in the past no longer applies and the literature supports treating colorectal cancer, Crohn's disease, diverticular disease, polyposis disease and ulcerative colitis minimally invasively. A minimally invasive approach is often preferred by the surgeon because the patient has less intra-abdominal scarring and adhesion formation.

Preoperative evaluation and selection criteria should consider factors that:

- Entirely rule out the procedure;
- Alter the planned surgical procedure either preoperatively or intraoperatively; and
- Suggest the need for preoperative adjuvant therapy.

The presence of a synchronous colonic neoplasia would rule out laparoscopic colectomy as a viable treatment option; therefore this should be identified preoperatively. A preoperative carcinoembryonic antigen (CEA) level provides useful information since it is elevated in the serum of patients with breast, colorectal, gastric, lung, and pancreatic cancer. Abdominal CT or hepatic ultrasonography also should be performed in patients with hepatomegaly. Patients with rectal cancer should have a careful digital palpation performed by an experienced physician combined with rigid protosigmoidoscopy.

At this time, there is no indication that a minimally invasive approach is associated with poorer long-term outcomes than open colectomy; therefore, there are very few true contraindications. However, some conditions make the minimally invasive approach more difficult, such as:[13]

- Intra-abdominal adhesions from prior surgical intervention;

- Bleeding disorders;
- Obesity; and
- Pregnancy.

Other factors that may preclude a minimally invasive approach include:[14]

- Patients with severe restrictive pulmonary disease – these patients cannot tolerate the acidosis generated by the carbon dioxide pneumoperitoneum. In addition, the restrictive pulmonary disease limits the rate of ventilation that can be provided by the anesthesia provider.
- Patients with large, bulky lesions – in these patients, larger incisions are required in order to obtain the specimen; therefore, it makes little sense to attempt a laparoscopic approach.
- Gender - men may be more difficult to operate on than women due to a greater prevalence of fat in the mesentery, regardless of overall body weight.

Laparoscopic-Assisted Colectomy

Laparoscopic colorectal surgery involves the use of several small incisions through which a specialized camera and several laparoscopic instruments are inserted. An insufflator is used to inflate the peritoneal cavity with carbon dioxide (CO2), thereby creating a pneumoperitoneum that provides a working space to perform the operation. Tilting of the operating room table in various positions during the procedure utilizes gravity to allow the intra-abdominal organs to fall away from the area of dissection, providing the requisite exposure that would normally be achieved through the use of retractors in an open procedure. Intestinal resection requires laparoscopic ligation of large vessels, mobilization and removal of a long floppy segment of colon, and restoration of intestinal continuity. Once the colon segment has been completely mobilized and its blood supply divided, a small skin incision is made to exteriorize the colon, a resection and anastomosis are performed extracorporeally, and the rejoined colon is placed back into the abdomen.[15]

Figure 3 – Laparoscopic-Assisted Colectomy

Though the benefits are clear, they have not been as compelling when compared to the clear advantages associated with other minimally invasive procedures. The primary reason is that a colectomy, whether open or minimally invasive, results in a delayed return of bowel function. Although this return of bowel function occurs sooner after minimally invasive surgery, the difference is approximately one or two days, resulting in a similar reduction in the length of hospital stay. Additionally, a minimally invasive approach is associated with longer operating times. Although the long-term benefits of open and minimally invasive techniques are equivalent, the short-term benefits are distinct advantages for the patient. In practical terms, a minimally invasive approach is associated with less pain, a faster recovery, earlier return of bowel function, a shorter hospital stay, possible immune benefits, and smaller scars, thereby making it the preferred method for intestinal resection.[16]

Most patients are suitable candidates for minimally invasive approaches; with an experienced surgeon, even patients with a history of prior abdominal surgery are candidates. Minimally invasive techniques have a somewhat long learning curve because of the advanced laparoscopic skills it involves. Unlike other laparoscopic procedures such as Nissen fundoplication or cholecystectomy, colorectal procedures entail dissection and mobilization of intra-abdominal organs in multiple quadrants.

The lack of tactile feedback during laparoscopic surgery can make tumor localization difficult, especially if the lesion location has not been tattooed on the colon wall prior to the procedure. It is imperative that the exact location of the tumor is known prior to proceeding with a colectomy. Even when the lesion location has been tattooed onto the colon, the mark can often be difficult to see, or there may be confusion regarding the location of the tattoo in relation to the tumor (either proximal or distal), which can affect surgical margins.[17] Other factors that increase the difficulty of laparoscopic-assisted colectomy include the following considerations:[18]

- Operative exposure is difficult to obtain.
- It requires the control of numerous vessels encased in a fatty mesentery.
- The 2-dimensional view and loss of tactile sensation increases the risk for injury to vital structures.
- In the presence of inflammation, mobilization of the colon becomes more difficult and the identification of vital structures becomes less obvious.

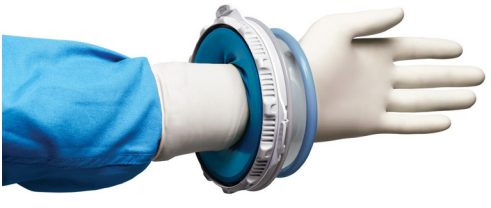
Hand-Assisted Laparoscopic Colectomy (HALC)

The laparoscopic-assisted approach continues to gain popularity and has evolved to include not only “pure” laparoscopic techniques, but also hand-assist devices. Hand-assisted laparoscopic surgery can be used as a bridge for surgeons who are not completely familiar with laparoscopic techniques; even for the most experienced laparoscopic surgeons, it is often the preferred technique for surgery involving left-sided pathology (that is, the descending or sigmoid colon and the rectum).[19] The use of a hand-assist device has several advantages, including: [20]

- A decrease in the learning curve associated with laparoscopy;
- The provision of tactile feedback for the surgeon; and
- Reduction of operating time, while still preserving many of the advantages of laparoscopic surgery.

By combining laparoscopic surgery with the tactile feedback of a hand-assist device, surgeons can not only reduce operating time, but also have a lower procedure conversion rate. The technique involves making an incision the width of a hand and placing a simple, ring-like hand-assist device to facilitate laparoscopic dissection (see Figure 3). New hand port devices facilitate this technique without the loss of pneumoperitoneum, which is essential for performing laparoscopic procedures. Because an incision (usually 4-5 cm) is necessary to remove the colon specimen at the end of a laparoscopic operation, the difference between a pure laparoscopic procedure and the hand-assisted technique is generally a few additional centimeters (usually 3-4 cm) of incision length. Several clinical trials have demonstrated that there is no difference in patient recovery or discharge for laparoscopic versus hand-assisted techniques.[21,22] This technique has particular advantages with overweight or obese patients, since larger incisions are often needed and also because of the increased risk of both wound infection and pulmonary complications.[23]

Figure 4 – Hand - Assisted Device



The latest generation of hand-assist devices allows the surgeon to insert the device at the beginning of the procedures and then use it as either a hand port or laparoscopic instrument port throughout the remainder of the procedure. The insertion site of the hand-assist device also provides a useful location for performing extracorporeal anastomosis and removal of a bulky specimen without contamination and a separate, larger incision, as noted above.[24]

HALC is most suited for laparoscopic procedures that will require an opening to remove an organ or specimen, or for extracorporeal anastomosis, including:

- Left colectomy;
- Sigmoidectomy;
- Low anterior resection;

- Abdominoperineal resection;
- Total abdominal colectomy; and
- Total proctocolectomy.

For these indications, HALC facilitates splenic flexure mobilization, inferior mesenteric vein and artery ligation, omental release, and rectal dissection. This technique is not indicated for right colectomy, ileocolic resection, ileal resection, or rectopexy without colon resection. [25]

Figure 5 – Hand-Assisted Laparoscopic Colectomy

A recent report in the literature noted that hand-assisted laparoscopic colorectal surgery may represent a viable hybrid alternative approach to standard laparoscopy. While only a few high-quality studies have been conducted, hand-assistance appears to reduce operative time when compared to straight laparoscopy for both left-sided segmental colonic and total colorectal resections. Furthermore, hand-assistance appears to maintain the short-term benefits of minimally invasive surgery, while affording the surgeon with the ability to carry out complex cases. Data pertaining to the use of hand-assistance for rectal cancer surgery are currently lacking, but on the whole, hand-assisted laparoscopic colorectal surgery appears to be a useful tool for the minimally invasive surgeon, one that is perhaps best thought of as an adjunct to simple laparoscopy.[26]

Energy Modalities

Hemostasis is essential for advanced laparoscopic surgical techniques, since uncontrolled bleeding may lead to major complications and even require conversion to open laparotomy in order to obtain adequate hemostasis. Coagulation of blood vessels during surgery involves the application of energy to denature tissue proteins so that the proteins adhere to each other and form a clot. In laparoscopic surgery,

questions exist about the safety of monopolar electrosurgery with regard to capacitive coupling, insulation failure/breaks, and unintended direct contact with other conductive instruments. Therefore, two additional types of energy modalities are used to achieve hemostasis in laparoscopic minimally invasive surgery: the ultrasonic scalpel and energy-based tissue cutting and sealing devices.

Ultrasonic Scalpel

The ultrasonic scalpel works by transforming electrical energy from a generator into mechanical energy through a piezoelectric transducer located between metal cylinders in the hand piece of the instrument. In response to the electric field, the waves, traveling from the hand piece to the blade, create mechanical vibrations. Silicon rings are located on the positions of the blade where the amplitude of the wave is zero in order to guide the blade.[27] These mechanical vibrations then drive the active blade of the device. Vibrating 55,500 times per second, when the blade comes into contact with the tissue and pressure is applied, the blood vessels are coapted; this coaptation denatures the protein in the cells, which then forms a sticky coagulum creating a hemostatic seal, thereby allowing the surgeon to simultaneously cut and coagulate. Ultrasonic scalpels achieve hemostasis with minimal lateral thermal damage. Safer dissection near vital structures can be accomplished because electricity is not passed to or through the patient, in contrast to electrosurgery or laser. Other clinical benefits include the elimination of direct coupling, capacitive coupling, insulation failure, pad site burns and stray electrical energy while allowing for precise cutting and controlled coagulation.

Ultrasonic scalpels have the following four mechanisms of action, which can be achieved singularly or in combination with one another; during surgical procedures, all of these effects are usually applied consecutively.[28]

- Cutting – the ultrasonic scalpel uses a combination of tension and pressure to rapidly stretch tissue, in contrast to electrosurgery, which uses extreme heat to vaporize and disrupt tissue. When the tissue reaches its elastic limit, the device tip can smoothly cut through it.
- Coaptation – the adherence of tissue is achieved by the disruption of hydrogen bonds, which causes collagen molecules to collapse and adhere to one another at a low temperature. The tissue is then transformed into a sticky coaptate.
- Coagulation – a rise in temperature following the application of ultrasound energy to tissue for a few seconds longer than it takes to achieve coaptation causes the release of water vapor and then coagulation. Coagulation is achieved by denaturizing protein, rather than defragmenting protein molecules as in coaptation.
- Cavitation – a side effect of the ultrasonic waves occurs when the high-frequency vibration of the device is transmitted to the surrounding tissue, which causes rapid volume changes of the tissue and cellular fluid; vapor bubbles are then formed at body temperature. The cavitation effect aids in tissue plane dissection, which enhances visibility in the operative field, which is particularly beneficial near vital structures or in anatomically remote regions.

Msika, et al.[29] investigated the feasibility and reliability of the ultrasonic scalpel in minimally invasive colorectal surgery in a nonrandomized prospective study of 34 consecutive patients undergoing minimally invasive colorectal surgery for benign disease and colorectal cancer. The authors concluded that coagulation and division of both minor and major vascular pedicles in laparoscopic colorectal surgery with an ultrasonic scalpel are technically easy, feasible, and reliable.

Energy-Based Tissue Cutting and Sealing Devices

While bipolar electrosurgery and ultrasound technology address some of the concerns noted above in regard to achieving hemostasis, they can be less than optimal for certain operative procedures. New energy-based tissue cutting and sealing devices have been developed that use direct thermal energy and simultaneous pressure to sequentially denature, seal, and then cut protein-based tissue. The ability to seal or hemostatically divide tissue is especially beneficial in laparoscopic and endoscopic surgery, as this versatility allows the surgeon to cut, coagulate, and dissect without exchanging instruments. These devices utilize a controlled application of a combination of heat and pressure to seal adjacent tissues, join adjacent tissues, or anastomose tissues. The tissue is heated for an optimal time, at an optimal temperature, and under optimal pressure to maximize tissue seal strength while minimizing collateral thermal tissue damage, allowing for safer dissection near vital structures. Vessels up to 7mm in diameter can be sealed effectively with this technology.

III. PERIOPERATIVE SPECIALTY TEAM

Dedicated Minimally Invasive Team

As noted above, minimally invasive colorectal surgery techniques continue to advance; therefore, the role of the perioperative specialty team takes on greater significance in this new era of surgery. All members of the team must remain aware of the latest developments in these techniques, as well as their role in the perioperative care of the patient. For patients undergoing minimally invasive colorectal surgery, coordination between the surgical team and the postoperative care team is essential in order to achieve all the benefits associated with this new approach to the management of colorectal disease.[30] The environment is technologically complex, but successful outcomes rely heavily on all members of the team working together. The specialty team for minimally invasive colorectal surgery – consisting of the surgeon, assistant, anesthesia provider, circulating nurse, scrub assistant, and perianesthesia care nurses – must be well-trained in both the surgical techniques and perioperative care of the patient, as developments in technology and procedural care continue to challenge team members.

It is helpful to first explore the meaning of the word "team." *Team* has been used so loosely and for so long in the healthcare field that in many ways, it has lost its true meaning; for example, six individuals in a room, each performing his or her own job, can be called a group, but not necessarily a team, since a team is defined by its members' interactions, interdependence, and shared goals.[31] Understanding the dynamics and the process of effective team building is imperative to developing a high performance minimally invasive specialty team. The team must have shared values and convictions of what is best for the patient. They must work together to develop procedures and protocols specific to the patient having minimally invasive colorectal surgery.

Figure 6 – Minimally Invasive Team

The traditional hierarchical culture of the operating room (OR) has been blamed for the failure of individuals to function as teams in this environment.[32] In the perioperative practice setting, as with all of health care, there is a close correlation between communication and safe care. [33] An ethnographic study of OR functioning classified 30% of procedurally relevant communications between team members as communication failures; over one-third of these communication failures led immediately to noticeable and potentially dangerous effects on system processes, such as inefficiency, team tension, resource waste, work-around, delay, patient inconvenience, and procedural error.[34] Poor teamwork and communication are latent human failures within an organization that must be addressed to achieve an effective safety program.[35]

Technical and Non-technical Skills

Successful surgical intervention depends on interdisciplinary teamwork, which is becoming increasingly specialized, particularly in the field of laparoscopic colorectal surgery. However, this teamwork consists of both technical and non-technical skills, defined as follows:[36]

- Technical skills consist of knowledge of anatomy, pathology, dexterity, hand-eye coordination, and technical proficiency.
- Non-technical skills include significant cognitive and interpersonal skills of healthcare professionals, such as communication, teamwork, leadership, situational awareness, and decision-making.

It has been shown that many of the underlying causes of errors stem from the non-technical aspects of care, rather than a lack of technical expertise; further, it is stated that improving non-technical skills could decrease the number of errors during surgery, and therefore improve patient safety.[37] Adequate preparation and familiarity with minimally invasive surgical procedures are prerequisite to teamwork. If the perioperative staff is unfamiliar with the routine and equipment, the patient and staff are at risk for injury. An adequately experienced and skilled team is essential for the effective performance of a safe, efficient procedure.

It is clear that perioperative patient care is much more than just technical skill and knowledge. A well-trained, well-organized, dedicated specialty OR team is needed to promote positive surgical outcomes for patients undergoing minimally invasive colorectal procedures. The surgeon must be an expert in the specialty of minimally invasive colorectal surgery in order to perform these procedures safely. In addition, perioperative nurses, scrub assistants, and surgical technologists also must develop and maintain expertise in all aspects of patient care. All team members must remain current with the tremendous advances in the evolving techniques and skills of minimally invasive colorectal procedures.

Individuals who comprise the minimally invasive colorectal surgery team will possess the skills of assessment, communication, critical thinking and technical skills. The sample care plan below outlines the assessment skills for the patient. Nurses who are dedicated to a team that focuses on one surgical specialty become proficient in communicating

information that will relieve the patients' anxiety related to the expectations of the surgical procedure. Goals of patient safety relate to your knowledge of the procedure, specific to the various colorectal procedures and the surgical approach. You can ensure the correct patient, correct site and correct procedure. Your team knows the nursing process for each minimally invasive colorectal procedure. The team has streamlined and standardized the preoperative, intraoperative and postoperative process. Efficiencies have been built into the process which ultimately reduces time and cost of the procedure. Procedure setup time has been streamlined and only those items needed for that procedure are opened and on the sterile field. This reduces the cost of the procedure as well as minimizes waste resulting from items not required for a procedure.

Patient positioning requires application of the principles of body mechanics, ongoing assessment throughout the perioperative period and coordination with the entire team. Consideration must be given to preexisting conditions such as poor nutritional status, extremes of age, vascular insufficiency, diabetes and impaired nerve function. The length of the procedure and the type of anesthetic may also contribute to positioning injury. The team has the responsibility of assessing each patient and position according to the procedure being performed. Postoperatively the patient must be observed for signs and symptoms of injury as a result of positioning.

Patient Safety

Another important component of the nursing care plan is "risk for injury related to the perioperative experience". Patient safety initiatives have put additional pressures on specialty teams. The minimally invasive team must be skilled in controlling the environment in which care is provided. The prevention of infection, fires and chemical and electrical hazards are essential. The dedicated minimally invasive team has experience in accessing susceptibility for infection by identifying pathophysiological risk factors, treatment related risk factors, situational risk factors and the predictors of the patients' risk for infection. Interventions include classification of the surgical wound using the Centers for Disease Control and Prevention guidelines, performing the skin preparation suitable to the type of surgery being performed. The team monitors for signs and symptoms of infection and protects the patient to exposure from cross contamination through their understanding and implementation of infection control practices. Their actions minimize operative time because they anticipate and coordinate as a team to set priorities and accomplish necessary tasks.

The team has the responsibility to ensure the patient is free from signs and symptoms of chemical injury. Hazards include cleaning solutions, skin prep solutions, pharmaceuticals, and tissue preservatives. Knowing the application and how to use each type of chemical is required in order to prevent injury. Consideration must be given to flammable solutions such as alcohol, acetone and fat solvents. The patient's skin must be observed for redness, rash, abrasion or blisters. It is important to communicate to anesthesia information regarding the patient's history of anaphylaxis, asthma or other respiratory difficulties related to the presence of allergens, toxins or antigens. Latex allergies are another risk for the patient.

Electrical devices are another source of injury to the patient having colorectal surgery. The minimally invasive specialty team is well versed on placement of the dispersive electrode pad and the use of the electrosurgical unit. They have established procedures that ensure the patient safety through identification of the risks and evaluation of the outcomes.

Patient Care Considerations/Nursing Care Plan

The patient scheduled for minimally invasive colorectal surgery presents unique challenges for the perioperative nursing staff. Once the patient arrives in the preoperative holding area, the nurse prepares the patient for surgery and compiles the medical record. The record is then checked for completeness by members of the perioperative team, including current history and physical examination, all laboratory and preoperative testing results, and surgical informed consent. The surgical procedure, patient's NPO status, allergies, and current medications are also verified and confirmed at this time.[38] Preoperative patient preparation steps then include:[39]

- Documentation that the site of the lesion has been confirmed with contrast radiology;
- Obtaining informed consent for possible conversion to an open procedure;
- Taking appropriate routine anti-thrombotic precautions, including administration of heparin and placing thromboembolic deterrent stockings;
- Completion of routine bowel preparation;
- Administering standard antibiotic prophylaxis; and
- Verifying the compatibility of all instruments and accessories.

See Table 3 for a sample nursing care plan, which outlines the nursing diagnoses, perioperative nursing interventions, outcome measurement, and outcome statements for undergoing minimally invasive colon surgery.

Table 3 – Sample Nursing Care Plan for Patients Undergoing Minimally Invasive Colorectal Surgery[40]

Nursing Diagnosis	Nursing Interventions	Outcomes Measurement	Outcome Statement
Anxiety related to deficient knowledge and stress due to surgery	• Assess psychosocial status, level of knowledge, and any barriers to communication. • Identify the patient's readiness to learn, coping mechanisms, and availability of support systems. • Explain the sequence of events. • Reinforce teaching regarding treatment options. • Provide preoperative and discharge instructions that are age appropriate and based on identified need; include family members as appropriate. • Communicate patient concerns to appropriate surgical team members. • Evaluate the patient's response to instructions.	The patient: • verbalizes understanding of the procedure and expected outcomes. • demonstrates knowledge of the emotional responses to surgical intervention. • verbalizes decreased anxiety and the ability to cope throughout the perioperative period.	The patient demonstrates knowledge of the psychological responses to the surgical procedure.
Risk for acute or chronic pain related to surgery	• Assess the patient's level of pain preoperatively. • Preoperatively, identify the patient's preferred level of postoperative pain control; provide pain management instruction based on a 0-10 pain scale and pain control options. • Identify the cultural and value aspects related to pain and pain control. • Implement pain guidelines by: - assessing level of pain control with a pain scale. - encouraging the routine use of analgesic agents. - providing instruction on noninvasive pain relief measures (e.g., relaxation techniques, distraction). • Evaluate the patients' response to pain management interventions.	The patient's postoperative vital signs and other nonverbal symptoms remain stable, which indicates adequate pain control. The patient reports and demonstrates adequate pain control throughout the postoperative period.	The patient demonstrates knowledge of pain management.

Risk for injury related to the perioperative experience	• Verify patient's identity, NPO status, allergies, and informed consent. • Assess skin integrity, musculoskeletal status, sensory impairments, and risk factors for ineffective tissue perfusion. • Ensure appropriate positioning and adequate padding of pressure points. • Evaluate for injury by comparison of preoperative and postoperative neurovascular status.	The patient's vital signs and oxygen saturation remain within expected values. The patient's motion, sensation, and circulation are maintained or improved throughout the perioperative period.	The patient is free from signs and symptoms of physical injury acquired during the perioperative period.
Risk for unplanned perioperative hypothermia	• Assess patient's risk for developing unplanned perioperative hypothermia. • Use appropriate perioperative hypothermia prevention strategies, including: - preoperative active warming. - applying temperature-regulation blanket. - minimizing unnecessary exposure. - using warmed solutions intraoperatively. • Evaluate the patient's response to hypothermia prevention interventions.	The patient's core body temperature remains within the expected range.	The patient is at or returning to normothermia at the conclusion of the immediate postoperative period.

IV. SUMMARY

Colorectal cancer continues to be a significant healthcare issue in the US today. Screening promotes early diagnosis, which is critical for optimal treatment and a favorable prognosis. Minimally invasive surgical approaches for colorectal surgical procedures offer patients exciting new treatment options, provide numerous clinical advantages, and are quickly becoming the standard of care for many colorectal surgical procedures. It is imperative that all members of the perioperative team remain knowledgeable about new surgical techniques and their role in patient care, as this highly technical, highly specialized field continues to evolve. In addition, the ongoing development of non-technical skills, such as communication, situational awareness, and leadership, supplements the technical skills necessary for effective teamwork. Through the enhancement of technical expertise as well as non-technical skills, the specialty surgical team can provide safe, quality perioperative care, thereby promoting positive surgical outcomes for this unique patient population.

V. GLOSSARY

Adhesion	An inflammatory band that connects opposing serous surfaces in the pleural or peritoneal cavity.
Anastomosis	The operative union of two structures.
Adenocarcinoma	A malignant tumor in epithelial tissue, specifically in a gland. Adenocarcinomas account for about 90-95% of all colorectal cancers.
Cavitation	The production of small vapor-containing bubbles or cavities in a liquid or tissue by ultrasound.
Cecum	The cul-de-sac lying below the terminal ileum, forming the first part of the large intestine.
Coaptation	The adherence of tissue achieved by the disruption of hydrogen bonds.
Colectomy	Surgical removal of all or part of the colon.
Colon	The part of the large intestine that runs from the cecum to the rectum as a long hollow tube that serves to remove water from digested food and let the remaining material, solid waste called stool, move through it to the rectum and leave the body through the anus.
Colon cancer	A malignancy that arises from the inner lining of the colon. Most, if not all, of these cancers develop from colonic polyps. Removal of these precancerous polyps can prevent colon cancer.
Colorectal	Related to the colon and/or rectum.

Colorectal cancer	Cancer of the colon and/or rectum. A malignant tumor arising from the inner wall of the large intestine. Risk factors include heredity, colon polyps, and long standing ulcerative colitis. Most colorectal cancers develop from polyps. Removal of colon polyps can prevent colorectal cancer. Since colon polyps and early cancer can have no symptoms, regular screening is important. Diagnosis can be made by barium enema or by colonoscopy with biopsy confirmation of cancer tissue. Surgery is the most common treatment for colorectal cancer.
Extracorporeal	Outside of the body.
Ileum	The terminal portion of the small intestine between the jejunum and cecum.
Mesentery	A fold of tissue that attaches organs to the body wall; blood vessels, nerves, and lymphatics branch through the mesentery. Mesenteries exist to support the small bowel, sigmoid colon, appendix, transverse colon, and portions of the ascending and descending colon.
Metastasis	The spread of cancer cells to distant areas of the body by way of the lymph system or bloodstream.
Pneumoperitoneum	The presences of air or gas in the abdomen, often induced artificially to achieve exposure during laparoscopic surgery.
Polyp	A mass of tissue that develops on the inside wall of a hollow organ, as within the colon or rectum. The word polyp is derived from the Greek words polys, many + pous, feet. Polyps may be benign, premalignant, or malignant.
Rectum	The terminal portion of the gastrointestinal tract, between the sigmoid colon and the anus.

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