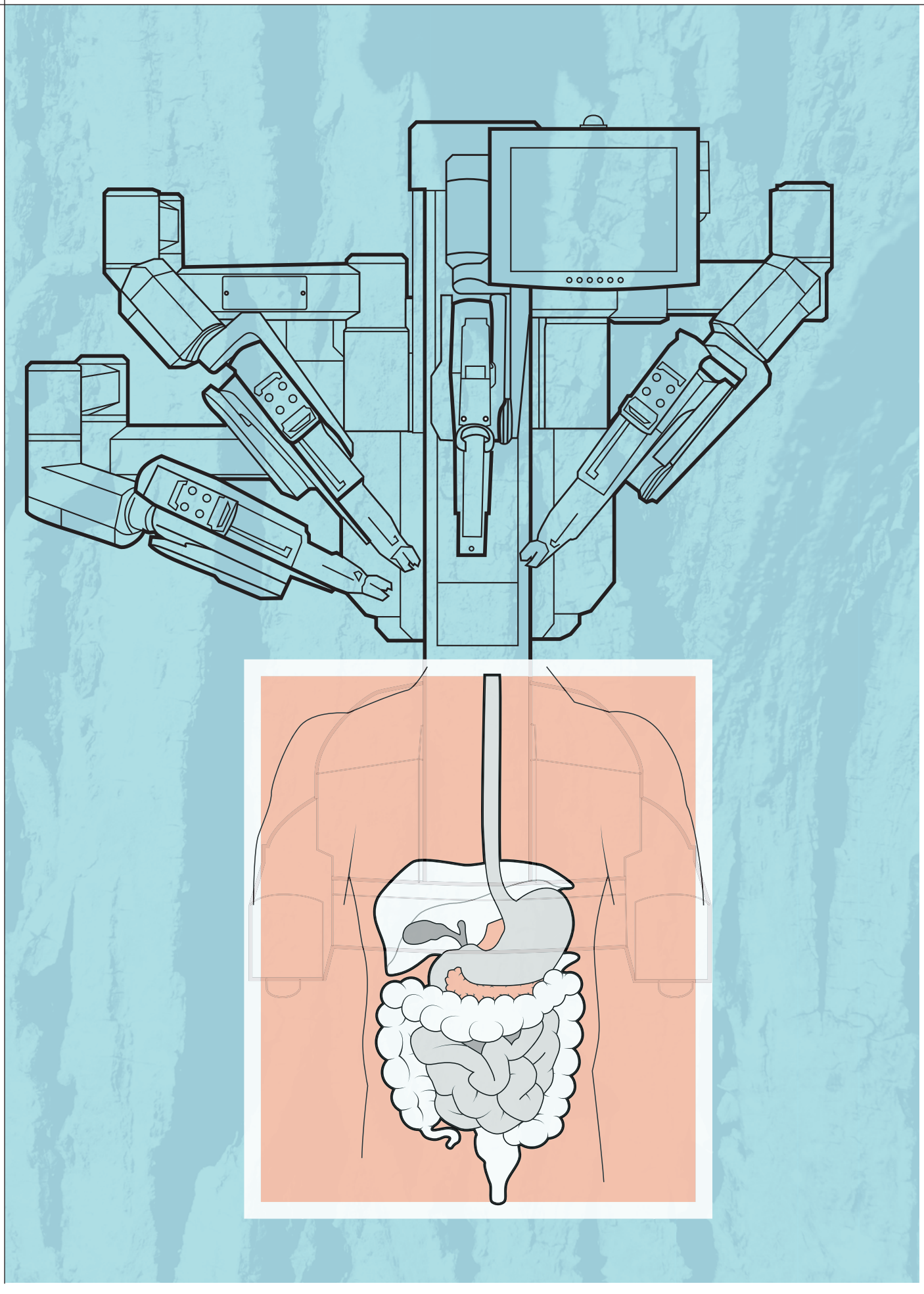

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Robotic-assisted laparoscopic bowel resection for diverticular disease

By Ruth L. MacGregor, MBA, BSN, RN, RNFA, CNOR

Diverticular disease is a prevalent medical condition that affects western populations; its incidence varies greatly worldwide and increases with age. Surgery may be an option but carries significant risk when it's needed for acute complications.[1] Robotic-assisted laparoscopic surgery is associated with decreased pain, morbidity, mortality, and hospital stays—it's a viable option for patients.

The risk of developing diverticular disease increases with age. Symptoms range from mild, low-level symptomatology, to acute episodes of diverticulitis that can be complicated with either an abscess or a perforation. Any surgery for the treatment of acute complications (perforation or abscess) and chronic complications (bleeding, obstruction, and fistula formation) carry significant rates of morbidity and mortality.

Laparoscopic surgery (as opposed to open colon surgery) can be associated with decreased pain, morbidity, and hospital stays, but its exact role isn't clearly defined. Prevention and medical management are treatments prior to surgery, but robotic-assisted laparoscopic surgery is a viable option for many patients with diverticular disease.

Statistics

Diverticulosis is mainly an age-dependent disease, and only 5% of people who have it are under the age of 40.[1] Once an individual reaches 65 years or older, the prevalence increases to 65%.[1] It's found mostly in developed countries and is believed to occur in westernized cultures where dietary fiber is lacking. Eighty percent to 85% of the patients with diverticula are asymptomatic.[1] A small percentage of patients who develop diverticulitis continue to progress with complications including abscess formations, fistulas, obstructions, or hemorrhage. When symptoms arise, diverticulitis is the most common clinical complication, as it affects approximately 10% to 25% of patients.[1] Most patients admitted with acute attacks respond to conservative therapies, but approximately 15% to 30% of them require surgery.[1]

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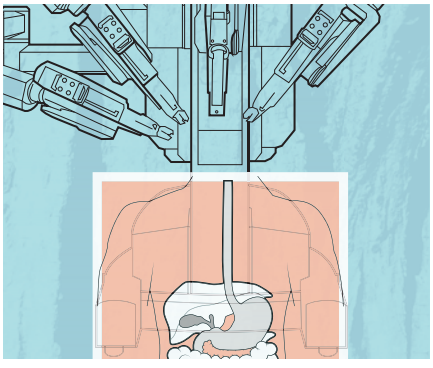
Sigmoid resection can be surgically performed in many ways. The traditional method is via an open abdominal incision; this type of procedure is performed approximately 53% of the time.[2] Another method is via hand-assisted laparoscopic surgery. A portion of this procedure is performed through a small incision made with a device that the surgeon's hand can fit through; this manner is performed approximately 30% of the time.[2] Additional surgical options include a laparoscopic bowel resection, which is performed 7% of the time, and the robotically-assisted laparoscopic bowel resection, which is only performed 2% of the time.[2]



Diverticulosis is a result of a herniation of the mucosa through defects in the muscle layer.

Definition of diverticulosis

Diverticulosis is a result of a herniation of the mucosa through defects in the muscle layer. These weak points in the colon typically occur where the vasa recta penetrate the colonic smooth muscle (see *Diverticular disease of the colon*). In colonic or "pseudodiverticular" diverticula, the weakening occurs in the mucosal and submucosal layers. This type of diverticula is observed in the distal colon—particularly in U.S. and European populations—where 90% of patients with diverticular disease have sigmoid colon diverticula, and 15% have right-sided diverticula. Proximal colonic diverticula, which is observed in Asians, involves all layers of the colonic wall. It's recognized that low-fiber diets play a role in colonic disease.[3]

Pathophysiology of the bowel

The colon begins at the ileocecal valve and ends at the rectosigmoid junction. It's approximately 4.5 feet (1.37 m) in length, 2.5 in. (6.35 cm) in diameter, and consists of six working parts. There's a tough outer muscular layer, a submucosal layer, and an innermost lining. Circular muscles in the inner layer initiate peristalsis. The ileocecal valve is a fold of mucous membranes located where the small bowel meets the colon. The appendix is attached to the bottom of the cecum, which is at the base of the colon. The ascending colon (which is on the right side of the abdomen) absorbs most of the water from the feces as it moves through. It ends at the hepatic flexure where the colon bends to the left and connects to the transverse colon. The transverse colon runs laterally across the abdomen and ends at the splenic flexure where the colon bends again. After the bend, the descending colon runs down the left side of the abdomen, ending at the sigmoid colon. The sigmoid colon angles to the right, curving down and inward, and then slightly upward; it connects to the rectum and rectal sac. This portion of the colon is approximately 8 in. (20.32 cm) long and goes to the anus. It's typically empty until mass peristalsis pushes stool into the rectum. The elasticity of the rectum allows it to expand, creating a sac to accommodate stools prior to elimination. The last inch of the rectum is considered the anal canal and anus. The opening of this canal is called the anus, and there are internal and external sphincters that keep it closed until the act of elimination.[4]

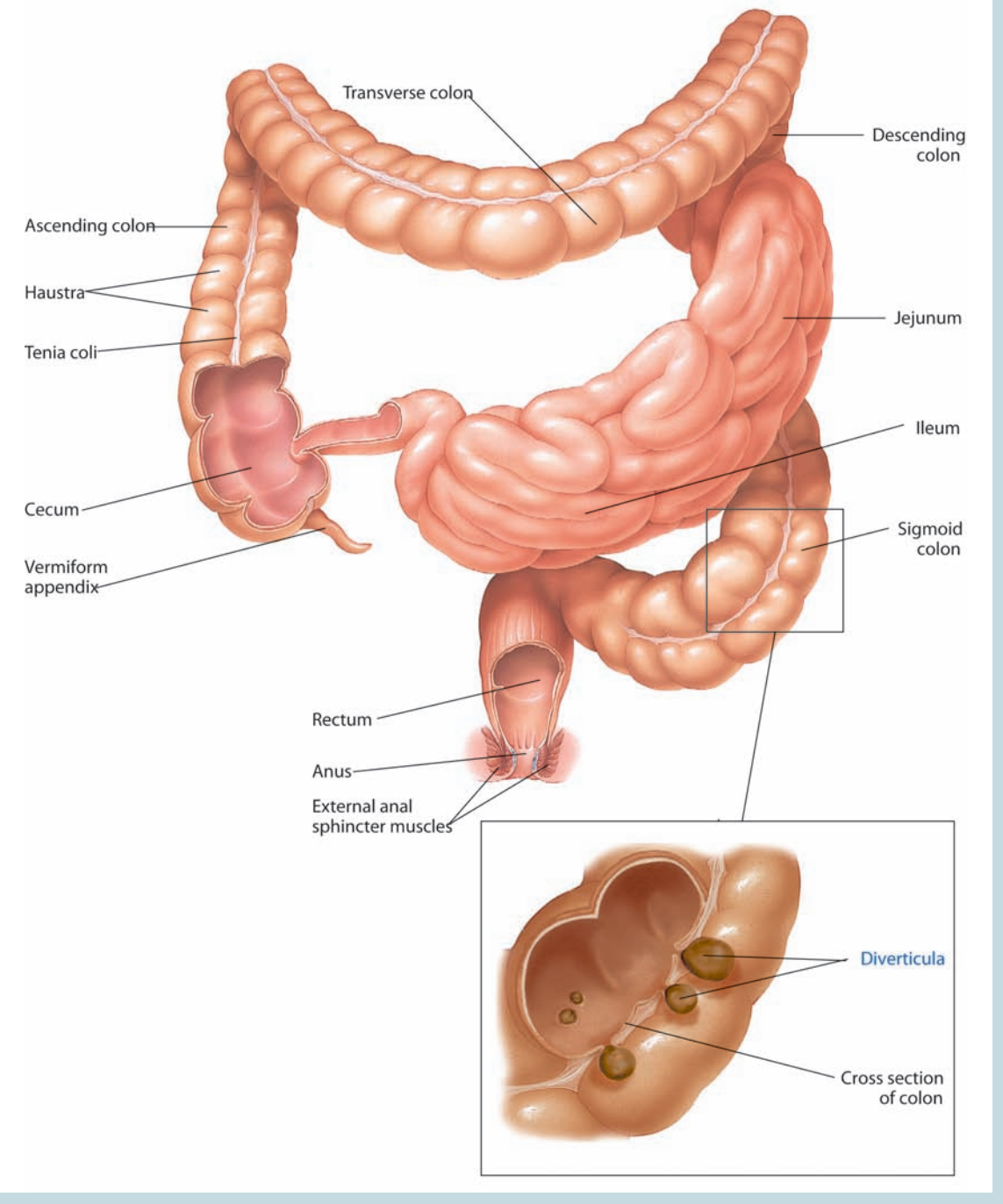
The purpose of the colon is to absorb water and electrolytes as well as propel and store unabsorbed fecal waste for evacuation.[5] Alteration in colonic wall resistance, disordered colonic motility, and dietary deficiencies—especially fiber—are concepts regarding the causes of colonic diverticula. More recently, inflammation is believed to have a role in diverticular disease.[6] The issue with diverticula is that fecal material may collect in the colon and cause an obstruction. The obstruction can, in turn, cause distension of the diverticula, form mucous secretion, and an overgrowth of normal colonic bacteria. Other concerns are vascular compromise, erosion of the diverticular wall, focal necrosis, the development of inflammation, perforation, abscess, fistulas, or peritonitis. Finally, repeated attacks of diverticulitis can result in a narrowing or obstruction of the colonic lumen from the formation of scar tissue.[5]

Stages of diverticulitis with corresponding diagnostic tests

Diverticulitis can be classified into four stages: development of diverticular disease, asymptomatic disease,

Diverticular disease of the colon

In diverticulosis, the diverticula (bulging pouches) in the gastrointestinal (GI) wall push the mucosa through the surrounding muscle. The sigmoid colon is the most common site for diverticula formation; however, they may develop anywhere along the GI tract from the proximal end of the pharynx to the anus.



Source: Anatomical Chart Company. *Atlas of Pathophysiology*. 3rd ed. Philadelphia, PA: Wolters Kluwer/Lippincott Williams & Wilkins; 2010:175.

symptomatic disease, and complicated disease. In symptomatic disease, there can be a single episode of symptoms that may include pain, abdominal distension/tenderness, diarrhea, and constipation, to recurrent, symptomatic diverticulitis, consisting of more than one attack per year of the same nonspecific symptoms: chronic, painful diarrhea and segmental colitis associated with diverticula (SCAD). Complicated diverticular disease is associated with inflammation, obstruction, abscess, fistulization, bleeding, and stricture.[6]

The clinical classifications are separated into three grades: Grade 1 is symptomatic, uncomplicated disease; grade 2 is recurrent, symptomatic disease; and grade 3 is complicated disease. In grade 1, the recommended diagnostic test is colonoscopy (versus barium enema), which is performed to rule out malignancy or colitis. In grade 2, the recommended diagnostic test is a computed tomography (CT) scan (versus barium enema), which allows the clinician to determine whether the patient needs hospitalization and/or surgery. The diagnostic test recommended in grade 3 is also a CT.[3]

One classification system that uses the CT scan to determine the severity of acute diverticulitis is known as the Hinchey classification. There are four stages with this classification: Stage I, pericolic abscess or phlegmon; Stage II, pelvic, intra-abdominal, or retroperitoneal abscess; Stage III, generalized, purulent peritonitis; and Stage IV, generalized fecal peritonitis.[3] The intraoperative findings of perforated diverticulitis have been correlated well using a retrospective clinical study with the Hinchey classification. In addition, patients often failed conservative treatment and were more likely to develop recurrent disease when the CT showed evidence of an abscess.[3]

In acute diverticulitis, approximately 15% to 30% of patients require surgery.[1] Surgery for acute complicated diverticultits is considered controversial due to the timing and type of surgery performed. The major concern is safety regarding whether or not the primary colonic anastomosis can be accomplished. Another debate looks at the likelihood of recurrence and prophylactic surgery for the resection of uncomplicated acute diverticulitis. Seven percent to 45% of patients are reported to have symptoms after an attack of acute diverticulitis.

Surgery at this time for uncomplicated diverticulitis has a higher mortality rate, but the response to medical treatment is less likely. Elective surgery is indicated after two attacks of diverticulitis. When assessing a patient for robotic-assisted laparoscopic surgery, many factors are considered including if the diverticulitis is acute complicated, acute uncomplicated, or chronic; severity of the diverticular disease, responsiveness to treatment, and comorbidities are also considered.[1]

In chronic or recurring diverticular disease, the patient's symptom scores have become a valuable tool in assessing their response to therapy. The European Association for Endoscopic Surgeons (EAES) has created a clinical classification system to determine the patient's symptom score. Grade I signs and symptoms consist of fever and crampy abdominal pain; Grade II, a recurrence of the former clinical signs and symptoms, and Grade III consists of abscess, hemorrhage, stricture, phelgmon, purulent and fecal peritonitis, perforation, and obstruction.[3] Surgery is recommended for patients who fail conservative medical therapies and progress to complicated diverticulosis and recurrent attacks.[3]

Preparing for surgery/preoperative care

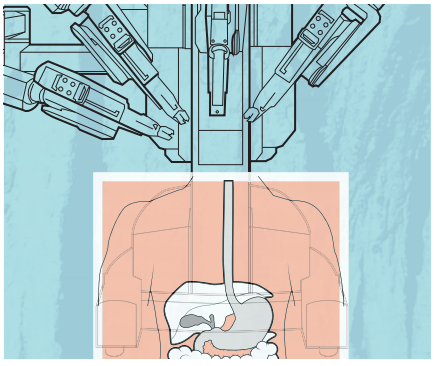
Once surgery is determined, the patient is usually scheduled with the Pre-Admission Testing (PAT) department. This department implements the anesthesia guidelines required for patients having surgery. The comprehensiveness of the assessment varies from patient-to-patient and takes into consideration their sex, age, type of surgery, type of anesthesia, and comorbidities. Assessments may include a lab work-up, chest X-ray, ECG, stress test, and medical clearance; this allows the patient to be in the most optimal health prior to the procedure. An anesthesiologist, physician, or an advanced practice nurse may perform a physical assessment on the patient. The anesthesiologist reviews the patient's information, preoperative diagnostic tests, and assesses the their risk for anesthesia complications such as a difficult airway or malignant hyperthermia risk.

Finally, patient education is provided to the individual and family. This is an ideal time to begin the education and provide the family and patient with handouts, answer any questions, and give information on support groups.

The patient arrives in the preoperative area on the day of surgery where the perioperative RN acts as a liaison between the patient, the anesthesiologist/nurse anesthetist, the surgeon, and the OR. Per The Joint Commission (TJC) recommendations, the RN will identify the patient using two designated patient

identifiers, verify that the OR consent, patient history, and physical assessment are complete, allergies are documented, and the patient has maintained N.P.O. status. In addition, the nurse ensures that the patient has an understanding of the surgery, knows which medication(s) they took/withheld, confirms that the bowel preparation was performed, and notifies the OR of the patient's arrival.

The perioperative RN can develop a positive relationship with the patient and family. Patient education is initiated to ensure that the individual comprehends what is required after the surgery in order to facilitate their return to optimal health. The RN documents that the surgeon has seen the patient prior to surgery, ensures the accuracy of all paperwork (including documentation of an I.V. catheter if inserted preoperatively), and surgical site marking if indicated.



The instrument arms used with the robot can articulate in angles that a human wrist is unable to, and the trocars are designed to operate on a fulcrum.

Intraoperative care

The OR nursing staff will ensure that all equipment is ready and available for the procedure. The sterile supplies needed for surgery are laparoscopic and specific robotic instruments designed to work with the robot. The robot needs to be turned on so it can perform checks, and the RN can ensure that it's in optimal working condition. Disposable supplies and drapes are also required for surgery; nondisposable equipment that is required includes stirrups, gel pad positioning devices, venous thromboembolism (VTE) prevention equipment, and a patient forced-air warming device.

Instruments that are used in an open-bowel resection need to be readily available. The surgeon may decide to operate on the patient via an open incision if the patient has extensive adhesions, bleeding, can't tolerate the pneumoperitoneum with carbon dioxide (CO_2) insufflation into the abdomen, or is unable to tolerate lying in a steep Trendelenburg position. These risks must be identified immediately or during the procedure, and the OR staff needs to be prepared to quickly set up or convert to an open procedure.

The robotic equipment

The robot consists of three pieces: the surgeon console, the patient side cart, and the vision tower. The robotic arms on the patient side cart and camera are covered with sterile drapes. Once covered, the scopes are attached to the camera and aligned for the surgical procedure. This converts two-dimensional images used in laparoscopic procedures into three-dimensional (3D) images, which is one of the benefits of the robot. The image is also magnified 10 times allowing the surgeon to see the anatomy up close.[7]

In addition, the instrument arms used with the robot can articulate in angles (wristed instrumentation) that a human wrist is unable to, and the trocars are designed to operate on a fulcrum. This allows for movement and doesn't pull on tissue, muscle, or fascia, minimizing pain. In traditional laparoscopic surgery, the trocars pull on the patients' tissue. Finally, these robotic procedures tend to have less blood loss. When the patients experience less blood loss, decreased pain, and small incisions, the benefit is that they have a shorter length of stay and return to optimal health more quickly.

There are other benefits of using the robot for colon resection: Lower circumferential positive margin rates, fewer anastomotic leaks and conversions to open surgery, superior exposure, counter traction and dissection of the rectum, improved autonomic nerve identification and preservation, unsurpassed ergonomics with equal access to left and right sidewalls,[8] and faster takedown of the splenic flexure.[9] Some of the benefits for patients are better clinical outcomes for cancer control, quicker return to a soft diet, significantly less pain, less blood loss, less risk of wound infection, shorter hospital stay, and shorter recovery time.[8]

Positioning and safety checks

The patient is moved to the OR table, and a safety strap is placed across the thighs. Once under anesthesia, the patient is positioned into a lithotomy position, which provides the surgeon the access

required to re-anastomose the bowel during a sigmoid resection. A cotton padding roll may be placed in the patient's hands to maintain proper position, and the patient's arms are padded and tucked along the side with thumbs maintaining proper alignment. The individual may lie on a gel pad; this assists in preventing movement on the OR table when in steep Trendelenburg position. Finally, an upper body forced-air warming blanket is placed on the patient.

Once positioned, the patient is tested in Trendelenburg position. This allows the surgical team to ensure that the patient doesn't slide on the OR table. It also helps the surgical team see if the patient will be able to tolerate being placed in this position.

Procedure

A time out is performed per hospital policy. The patient is prepped and draped in a sterile manner, and then the abdomen is insufflated with CO_2 so that the trocars can be safely placed in the abdominal cavity. The camera has a 12-mm port, which is placed 3 cm to 4 cm to both the right and above the umbilicus. The distance to the symphysis pubis (SP) is 22 cm to 24 cm. The right robotic port is placed a minimum of 8 cm from the endoscope port on the right spino-umbilical line (SUL) crossing the midclavicular (MCL) line. The distance to the SP is 14 cm to 16 cm. The left robotic port is placed 6 cm lateral of the left MCL, about 3 cm to 4 cm cephalad to the SUL; the distance to the SP is 16 cm to 18 cm. The third robotic port is placed 3 cm to 4 cm subxiphoid, halfway between the right MCL and midline, while the fourth robotic port is placed 7 cm to 8 cm below the left costal margin, slightly medial to the left MCL. Finally, an assistant port is placed 8 cm to 10 cm cephalad to the right instrument port, which is used for suction/irrigation, ligation, and retraction. Depending on the stage of the procedure, the robot is docked to different ports in order to have optimal use of the arms.[10]

Once the ports are placed, the surgeon will assess the abdomen and provide the initial exposure for the procedure. The small bowel is retracted out of the pelvis and into the right upper quadrant—the greater omentum is positioned over the transverse colon. In women, the uterus is suspended using a suture through the fundus or around each round ligament. The abdominal cavity is then inspected for metastatic disease. The robot is then moved over the patient's left lower body at a 45-degree angle and then docked to the trocars.[10]

The next step is to gain primary vascular control by incising the peritoneum at the sacral promontory. The surgeon will look for pulsations of the internal mesenteric artery (IMA). The dissection is continued superiorly along the aorta to the root of the IMA; it's skeletonized, clipped, and ligated. The pedicle is retracted, and the surgeon will dissect superiorly toward the ligament of Treitz. Afterward, the internal mesenteric vein (IMV) is identified, skeletonized, clipped, and ligated close to the inferior border of the pancreas.[10]

Medial to lateral mobilization of the sigmoid and descending colon is the next step achieved. First, the IMA is followed, and the rectosigmoid mesentery is retracted. The surgeon bluntly dissects the avascular place between the Toldt fascia and the left colonic mesentery. Once the hypogastric nerve plexus, gonadal vessels, and ureters are identified, the dissection is continued laterally. The sigmoid-descending colon junction is detached and then retracted to apply tension on the "white line" of Toldt; then the lateral attachments of the descending colon are dissected. Finally, the plane from the previously performed medial dissection is joined.[10]

Splenic flexure mobilization follows by continuing the prior dissection plane cephalad and anterior to Toldt fascia. The transverse mesocolon is then opened above the body of the pancreas to enter the lesser sac. The transverse colon is rolled caudally to help apply traction. At the middle third of the transverse colon, the omentum is dissected in the avascular plane that is continued posteriorly, and the lateral attachments are divided.[10]

Once completed, the posterior rectal dissection is initiated, and the robot is re-docked. The sigmoid colon is retracted cephalad and to the patient's left side. The mesorectum is dissected from the presacral fascia including a dissection between the mesorectal fascial and the presacral fascia. The dissection is continued distally with Waldeyer fascia opened and then dissecting to the pelvic floor.[10]

The rectum is dissected laterally, lateral ligaments are divided, and the dissection is continued until the levator ani muscle is exposed on both the right and left side. The hypogastric nerves, and more distally, the pelvic nerve plexus, are spared.[10]

The last portion of the rectal dissection is the anterior dissection. The plane between the rectum and

Patient education for diverticular disease[11,12]

The perioperative nurse initiates patient teaching during the preoperative phase, and the RN on the surgical unit continues patient teaching throughout the recovery phase to prepare the patient for discharge. This is an important aspect of nursing care that will assist the patient in managing his or her disease as well as recognizing and treating symptoms early.

It's important for the patient to know that eating a high-fiber diet can help reduce the risk of diverticular disease. Foods that are high in fiber are fruits (such as apples, peaches, pear, and tangerines), vegetables (such as fresh broccoli, squash, carrots, and spinach), starchy vegetables (such as potatoes, baked beans, kidney beans, and lima beans), and grains (such as whole wheat bread, brown rice, bran flake cereal, and oatmeal).

Other important aspects the patient can do to manage the disease are increasing fluid intake, exercising, and paying attention to any symptoms that develop. A person should drink at least eight glasses of water a day (unless the patient has a comorbid medical condition and has been given specific fluid intake instructions from his or her healthcare provider), which will replace lost fluids as well as assist with the high-fiber diet. Fiber acts as a sponge, and increased amounts of water will assist in preventing constipation. It's also important to teach the patient to listen to the body's urge to go and not to put off bowel movements; this causes more pressure to eliminate the waste that can worsen the disease. Physical activity can also help prevent constipation. Explain to the patient the importance of regular physical activity. These activities include walking and other activities that the patient enjoys such as swimming, dancing, bicycling, or gardening.

Finally, antibiotics may be prescribed if the patient has an episode of diverticulitis. Early identification and communication with the patient's healthcare provider is essential. The patient should be instructed to follow up with his or her healthcare provider if signs and symptoms of acute diverticulitis (abdominal pain, cramping, fever, chills, nausea, vomiting, or a change in bowel habits) are present, so that if antibiotics are required, the medication is initiated early. Diet modifications (clear liquid to low-fiber diet) to rest the colon during an acute episode are also important to initiate early, as well as other necessary interventions, including hospitalization, based on the severity of the acute episode.

prostate (in male patients) are divided, the seminal vesicles are identified, and the Denonvilliers fascia is exposed. The dissection should reach the pelvic floor circumferentially. Once attained, the rectal division can be completed.[10]

A digital rectal exam should be performed to assess the distal margin prior to the rectal division. The right lower quadrant robotic cannula should have the 12-mm port with an 8-mm downsizer; the downsizer is used when the robot arm is docked. At this point of the procedure, the downsizer is removed, and the assistant will use the 12-mm port to insert the linear stapler; it's aligned at a right angle to the rectum and is divided once in place. The transected portion of the bowel is moved into the abdominal space. The pelvis is inspected to ensure that the right and left hypogastric nerves and nervi erigentes are visualized and not bleeding.[10]

After completion, the robot is undocked, and the left lower quadrant port is extended to a 4-cm minilaparotomy. A wound protector is placed, and the specimen is removed from the abdominal cavity. The colon is divided proximally, and a circular stapler anvil is secured in the colon using a purse string; the colon is returned into the abdominal cavity, and pneumoperitoneum is restored. Under laparoscopic vision, the circular stapler is placed into the rectum, and the spike/anvil are connected. Once the surgeon ensures that the colon is aligned and not twisted, the staple is fired to create the anastomosis. A leak test is performed, and an inspection of the anastomosis and "donuts" on the stapler is conducted for completeness.[10]

The surgeon will ensure that the patient's abdominal cavity is free from bleeding. The trocars are removed, the pneumoperitoneum deflated, and the port and incision sites are closed. Anesthesia is stopped, and the patient is transferred to the postanesthesia care unit (PACU).[10]

Postoperative care

Postoperative care is multifaceted, as it includes the immediate recovery of a patient from anesthesia (in the PACU) as well as patient education (see *Patient education for diverticular disease*). Immediate postoperative care includes frequent monitoring of the patient's vital signs, pain level, fluid status, and early recognition of any complications from the surgery or anesthesia.

In the next phase of care, the patient is encouraged to become ambulatory. In addition, the patient's bowel is assessed until they are able to tolerate a soft diet. It's important to be confident that there isn't an anastomosis leak prior to discharge from the hospital.

Moving forward

Diverticular disease is prevalent in western populations (especially in older patients); it ranges from asymptomatic to complicated symptomatic disease. Complications experienced are associated with high risks including increased morbidity and mortality. Robotic-assisted laparoscopic surgery is an option for some types of bowel disease and provides various benefits that facilitate a patient's return to good health. Education and early recognition of symptoms are key aspects in assisting patients to manage the disease—including diet and exercise—and can help one manage the disease or prevent the development of diverticular disease. **OR**

REFERENCES

1. Comparato G, Pilotto A, Franzè Franceschi M, Di Mario F. Diverticular disease in the elderly. *Dig Dis.* 2007;25(2):151-159.

2. Intuitive Surgical. *da Vinci Colorectal Surgery: Technical Presentation.* Intuitive Surgical; 2008.

3. Sheth AA, Longo W, Floch MH. Diverticular disease and diverticulitis. *Am J Gastroenterol.* 2008;103(6):1550-1556.

4. Health Online Plus—Medicine Library (2007) *Anatomy and Physiology of the Colon.* Retrieved September 24, 2012 from Health Online Medicine Library: http://medicine.holplus.com/Medical/Anatomy/Anatomy-and-Physiology-of-the-Colon.html.

5. Nguyen MC, Chudasama YN, Dea SK, Cooperman A. *Diverticulitis.* 2011. http://emedicine.medscape.com/article/173388-overview.

6. Kang JY, Melville D, Maxwell JD. Epidemiology and management of diverticular disease of the colon. *Drugs Aging.* 2004;21(4):221-228.

7. Intuitive Surgical, Inc. *da Vinci SI HD Surgical System.* 2012. http:// http://www.intuitivesurgical.com/products/davinci_surgical_system/davinci_surgical_system_si/.

8. Hellan M, Anderson C, Ellenhorn JD, Pigazzi A. Short-term outcomes after robotic-assisted total mesorectal excision for rectal cancer. *Ann Surg Oncol.* 2007 Nov; 14(11):3168-73.

9. Pigazzi A, Ellenhorn JD, Ballantyne GH, Paz IB. Robotic-assisted laparoscopic low anterior resection with total mesorectal excision for rectal cancer. Surg Endosc. 2006 Oct; 20(10):1521-5.

10. Intuitive Surgical. da Vinci Low Anterior Resection-Full Length Procedure. 2008. http://search.davincisurgerycommunity.com/index.php?N=4294962608+4294962190+4294964011&Ns=0&lmi=.

11. National Digestive Diseases Information Clearinghouse. National Institute of Diabetes and Digestive and Kidney Diseases of the National Institute of Health. Diverticulosis and Diverticulitis. http://digestive.niddk.nih.gov/ddiseases/pubs/diverticulosis/. Updated February 21, 2012.

12.Newman Regional Health. Patient Education. Diverticulitis. November 2006. http://www.newmanrh.org/Portals/490/Skins/IH-NRH/files/PatientEducationSheets/Diverticulitis.pdf.

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