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Operative Approach to Rectal Cancer: An Anatomical and Technical Description

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1. INTRODUCTION

It is estimated that 140,250 Americans will be diagnosed with and 50,630 Americans will die of colorectal cancer in 2018 making it the second leading cause of death in the United States. Specifically, there will be almost 43,030 new rectal cancer cases diagnosed this year [1,2] Rectal cancers have historically been more difficult to treat secondary to their high local recurrence rates, and based upon characteristics of the lesion such as size, extent, and location, current surgical treatment includes transanal excision, low anterior resections, coloanal anastomosis, and abdominoperineal resection.

After introduction of abdominoperineal resection in 1908 by Ernest Miles [3] local recurrence rate decreased to about 30% versus a dismal prior near 100% recurrence rate [4]. With the development of new surgical technology such as anastomotic staplers, low anterior resection and other "sphincter preserving" surgeries gained popularity in the 1950s and were associated with recurrence rates ranging from 12 to 38%. [5]

Total mesorectal excision (TME) is the *enbloc* complete resection of a rectal tumor including the lymphovascular tissue that surrounds the rectum and its mesentery, the so-called "mesorectal envelope." This technique, described by Heald et al in 1979, includes dissection between the parietal and the visceral pelvic fascia along the presacral curve, the so-called "Holy Plane." [5,6] Heald based his techniques on observations that embryologically the mesorectum, its blood supply, lymphatic drainage, and overlying visceral fascia are anatomically distinct from the underlying parietal peritoneum. Indeed, if performed correctly the TME develops an almost bloodless plane between the specimen and its surrounding tissues which obeys sound oncologic principles for complete resection. This technique has become the standard of care in many countries including the United States for the surgical treatment of mid and low rectal cancers. [7,8]

Quality of the surgical technique within the context of interdisciplinary care, influences outcomes of rectal cancer particularly locoregional recurrence. It is also an important component of the standards developed by The National Accreditation Program for Rectal Cancer (NAPRC) in collaboration between The OSTRiCh Consortium (Optimizing the Surgical Treatment of Rectal Cancer) and the Commission on Cancer (CoC), a quality program of the American College of Surgeons. Development of such accreditation is an effort to improve the quality of care for rectal cancer patients and thereby reduce the variability in outcomes that are contingent upon specialty training, case volume, and systems development. [9] The purpose of this review is to describe the anatomical basis, technical aspects of open and laparoscopic pelvic nerve sparing total mesorectal resection and the reconstruction methods of colorectal/colo-anal anastomosis.

1.1. An Anatomic Discussion of Total Mesorectal Excision

The surgeon's understanding of the anatomy of the rectum and mesorectum and its associated structures has evolved through the past one hundred years through examination of embryology, operative resection, cadaveric dissections, and longitudinal studies. Through these endeavors, we gain a better understanding of the surgical planes of dissection for complete removal of a rectal cancer and its potential lymphatic spread. The rectum and proximal anal canal are derived from

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the hindgut. The cloaca, or lower part of the hindgut, is contiguous to the cloacal membrane, and the allantois opens on the ventral aspect of the cloaca. The urorectal septum develops between the allantois and the cloaca forming the urogenital sinus anteriorly and the anorectal canal posteriorly. The septum eventually fuses with the cloacal membrane and becomes the perineal body in adults. These relationships help guide the plane of dissection in a successful TME and assist the surgeon to understand the relationship between the autonomic nerves and the parietal fascia within the pelvis.

1.1.1. Blood Supply and Lymphatics

Embryologically, the primitive gut receives its blood supply, venous drainage, and lymphatic supply through a dorsal mesentery, and persists as the mesorectum for the hind gut. The arterial blood supply to the rectum is from the inferior mesenteric artery, which arises from the aorta at approximately the level of the third lumbar vertebra. It further branches into the left colic artery, variable sigmoid branches, and the superior rectal artery which supplies the superior third of the rectum. The middle rectal artery supplies the middle rectum, providing a significant supply in approximately 20% of people. The inferior rectal artery branches from the hypogastric artery supplying the distal third of the rectum. Knowledge of the anatomic variability of colic blood vessels is crucial during rectal surgery. The venous drainage of the rectum follows that of the arteries. The superior rectal vein drains via the inferior mesenteric vein (IMV) into the portal circulation whereas the middle and inferior rectal veins drain via iliac veins into the systemic circulation.

1.1.2. Mesorectum

The mesorectum contains the blood supply and lymphatics draining the rectum. It is surrounded by a layer of fascia that envelops the mesentery and is a "bloodless" surgical plane that separates the mesorectum from the presacral fascia (Fig. 1). This is the plane of dissection for the surgeon where erring into the mesentery may compromise an adequate resection and erring outside of this plane may injure autonomic nerves and may render the patient impotent. There is also the potential for injury to the presacral venous plexus leading to considerable hemorrhage. In the superior third of the rectum, the mesorectum lies on the dorsal aspect. The anterior aspect of the rectum is covered by the peritoneal reflection and forms the pouch of Douglas – a site of metastases that can be palpable on digital rectal exam as "Bloomer's shelf". In the middle third, the rectum is separated from the posterior aspect of the prostate in males and the vagina in females by Denonvilliers fascia, known by some as the rectogenital septum. In the middle third, the mesorectum expands posterolaterally. The surgical plane posteriorly lies between the visceral fascia and the presacral fascia and consists of avascular areolar tissue. At approximately the fourth sacral vertebra these two fascial layers come together to form the rectosacral ligament which is divided during surgical dissection. In the lower third, the anterior aspect of the rectum is almost bare, with little to no fat lying between it and the prostate or vagina.

1.1.3. Pararectal Fascia

At the junction of the middle to distal third of the rectum, the fascia propria that surrounds the rectum and mesorectum extends laterally to form "lateral stalks" that contain the middle rectal arteries and autonomic nerves branching from inferior hypogastric plexus (pelvic plexus) innervating the rectum laterally. These lateral stalks or "lateral ligaments" have been the source of some debate among surgeons and anatomists. In 2000, Takahashi et al. studied 421 patients who had undergone rectal resection and described the lateral ligament as "a condensation of connective tissue around the middle rectal artery and divided into two segments by the inferior hypogastric nerve plexus inside it and the visceral endopelvic fascia around it" suggesting that it "is a pathway of blood vessels and nerve fibers toward the rectum and lymphatic vessels from the lower rectum toward the iliac lymph nodes." Errors in dissection here and injuries to these lateral ligaments can lead to sexual and urinary dysfunction.

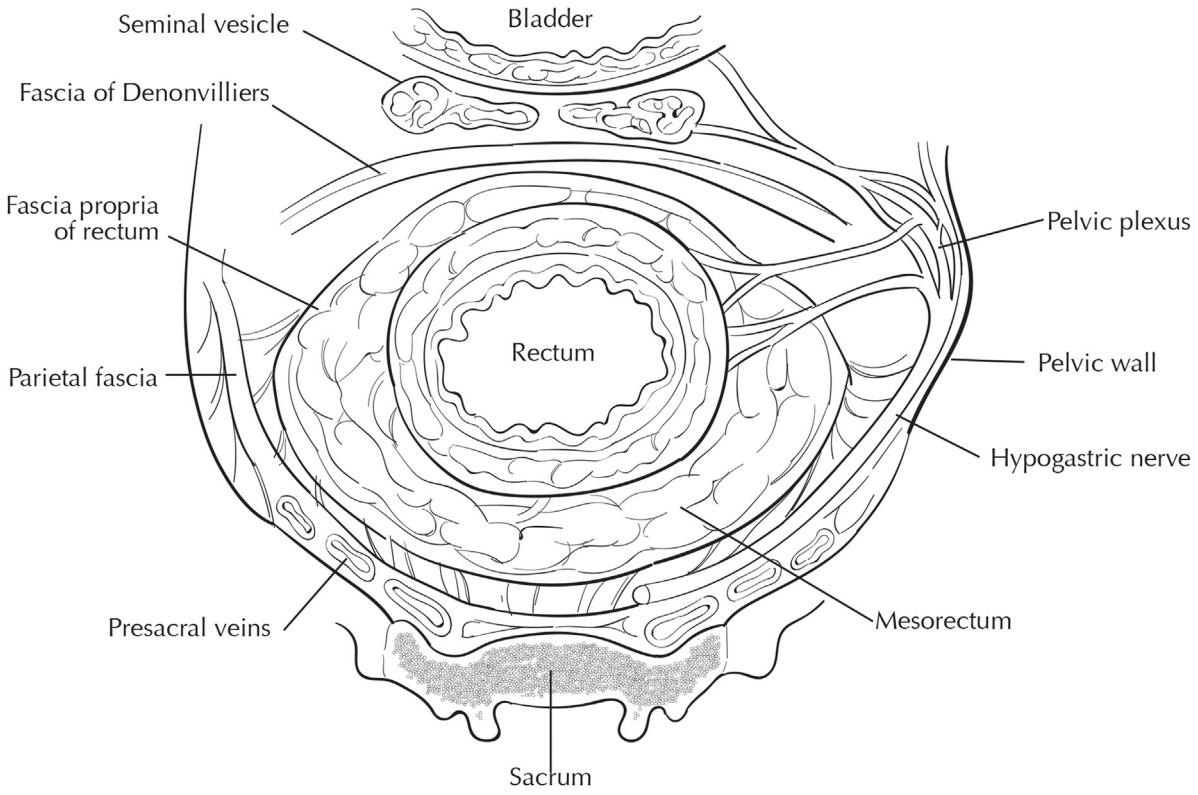

Fig. 1. Axial view of the rectum demonstrating the relevant anatomical structures to perform nerve sparing total mesorectal resection.