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Review

Safe anastomosis in laparoscopic and robotic low anterior resection for rectal cancer: A narrative review and outcomes study from an expert tertiary center

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Abstract

Anastomotic leak and stricture formation are recognised complications of colorectal anastomoses. Surgical technique has been implicated in its aetiology. The use of innovative anastomotic techniques and technical standardisation may facilitate risk modification. Early detection of complications using novel diagnostic tests can lead to reduction in delay of diagnosis as long as a standard system is used. We review our practice for creation a safe anastomosis for minimal invasive rectal cancer resection. Several technical points discussed and evaluated based on the evidence. We propose several recommendations aiming to standardize the technique and to minimize anastomotic complications.

Keywords: Anastomosis; Rectal cancer; Laparoscopic

Introduction

The most important complications after rectal anastomosis are leak and stricture.

Rectal anastomotic dehiscence is a serious life-threatening complication with high morbidity and significant impact on length of hospital stay. Dehiscence may also increase the risk of tumour local recurrence and lead to poor outcomes.[1,2] The reported anastomotic leak rate after elective anterior resection varies from 1% to 30% with higher rates reported after emergency surgery.[3–5] The mortality rate is reported between 6 %–22%.[6–8] The International Study Group of Rectal Cancer (ISREC)[9] defines anastomotic leak as a communication between the intra- and extraluminal compartments due to a defect of the integrity of the intestinal wall at the anastomosis between the colon and rectum or the colon and anus. Bruce et al.[10] divided the anastomotic leak into three groups: radiological (no clinical signs), clinical minor (no intervention needed), and clinical major (intervention required) leak.

A benign anastomotic stricture after colorectal anastomosis is another common complication reported in3%–30%.[11–14] Local recurrence of tumour was reported to be the cause of 25% of these strictures.[15,16] It most commonly involves the middle and lower rectum.[11,17] Definitions of strictures are variable, however a significant stricture broadly presents with symptoms[12,14] of difficult passage of colonic content, prolonging passage of stool from a stoma site if previously performed.

Better understanding of the risk factors for these post-operative adverse events will allow us to design strategies for reduction of morbidity and mortality post low rectal anastomosis for colorectal cancer.

Several factors have been reported to play a role in anastomotic leak or stricture. These may be modifiable or non-modifiable. Factors can be classified into general; age, sex, obesity, diabetes mellitus, smoking, lung disease, nutrition,

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fluid transfusion, duration of the operation, long-term corticosteroid therapy, non-steroidal anti-inflammatory drugs, ASA score, and local; procedure, level of anastomosis, type of anastomosis, tension on anastomosis, blood supply to anastomosis, stapling (donuts, transection, double stapling, mechanical forces), radiation therapy, air leak test, stoma.[18–23]

Of the general factors, cessation of smoking, nutritional support and fluid directed therapy are important modifiable factors for reduction of the incidence of the leak and stricture. From the surgeon-controlled local factors, tension on the anastomosis, vascular supply, stapler use, stoma creation and air leak test are all modifiable.

Radiation therapy should be determined by the pre- or postoperative stage, whilst the type of the procedure and level of anastomosis depends on the tumor location.

Among numerous causes of colorectal anastomotic leak, surgical technique is the most significant one.[24] Surgeon-related factors may play a role, with wide ranges in the reported rate of leak by individual practitioners (0%–30%).[3,24]

Several comparative studies of laparoscopic and open surgery for rectal cancer have reported no statistical difference in anastomotic leakage. However, recent studies have reported that the rate of anastomotic leakage after laparoscopic surgery remains low at approximately 1%–19%.[24–27]

We reviewed our technique for performing safe anastomosis in laparoscopic and robotic low anterior resections at a high volume center (more than 1500 colorectal cancer cases per year) at Yonsei University College of Medicine, South Korea, with a focus on modifiable risk factors for anastomotic leak and stricture. Additionally, we performed a narrative review of the literature using PubMed, Embase, and Google Scholar, looking for modifiable risk factors for anastomotic complications. We included open cases, as well as laparoscopic and robotic resections, with particular focus on the technical advances in minimal invasive instruments and anastomosis devices that may potentially improve the safety of anastomosis. We have provided guidelines and a summary of our recommendations after the discussion of each factor.

Technical points

Blood supply

Inferior mesenteric vein (IMV) ligation

In our institute, we mobilise the colon on both the medial and lateral aspects to achieve a tension-free anastomosis. Dissection along the medial side of the colon, on the mesenteric "vascular side", should be performed by ligation of the inferior mesenteric vein at the lower border of the pancreas. Careful attention should be paid to this area in what we call the"IMV critical zone".[28] In our recently published article, we studied this zone in detail and we found that in type A and B (Fig. 1a, b, c) the arc of Riolan "meandering" artery passes across the IMV or parallel to it respectively. In type C no collateral artery is present around the IMV. Thus ligation of IMV at these levels needs to be carefully attempted to avoid injury to the collateral vessels.[28] In certain circumstances the collateral vessels will be supplying the descending colon while the marginal artery is absent so incidental injury to collateral vessels might lead to ischaemia, necrosis, leak and stricture.

- We recommend careful dissection of the IMV to avoid injury to the collateral artery.

Inferior mesenteric artery (IMA) ligation

After the retraction of the superior rectal artery (SRA) upward, medial dissection around the sacral promontory is started using the aortic bifurcation as a landmark. The dissection continues in a cephalic direction parallel to the aorta until we meet the IMA. Low versus high ligation of the IMA is still widely debaited in the literature. Ligation of superior rectal and sigmoid artery with lymph node dissection around the IMA root is routine in our institute. IMA lymph node dissection is a method to avoid oncological compromise during low ligation. Trying to preserve the left colic artery will give additional blood supply to the anastomotic site alongside the marginal artery. However, in the case of radiological positive lymph node around the IMA or ultra low anterior resection we prefer high ligation.[29] Orsay et al.[30] evaluated blood supply to the rectal anastomosis and compared the incidence of stenosis between ligation and preservation of the IMA, showing no relationship between them.

Lange et al.[31] systematically reviewed publications concerning the level of ligation in rectal cancer surgery. They included 23 articles that evaluated oncologic outcome ($n = 14$), anastomotic circulation ($n = 5$), autonomic innervation ($n = 5$) and tension on the anastomosis/anastomotic leak ($n = 2$). They concluded that insufficient evidence exists to support high ligation as the technique of choice. Furthermore, high ligation has been confirmed to decrease perfusion and innervation of the proximal limb of the anastomosis.

- We recommend low ligation with preservation of left colic artery to augment blood supply to the anastomosis. This is especially important in low flow or absent marginal vessels.

Indo-cyanine green (ICG)

We are proud to be the first institute in Korea to use the robotic ICG.

Using the robotic Da Vinci Si system, ICG florescence can identify the collateral vessels at the IMV critical zone clearly so we can avoid injury to them. This is especially useful in thick mesentery where the visualization of the vessels is difficult. Moreover, it can be used to identify the IMA arterial divisions and facilitate preservation of left colic artery. Thrombosis of the left colic artery can also be visualized in this manner. This information helps inform the decision of low versus high ligation. Another function of this technique is in selection of the proximal resection