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**Isoperistaltic vs. antiperistaltic anastomosis after right hemicolectomy: a comprehensive review**

Symeonidis *et al.* Isoperistaltic vs. antiperistaltic anastomosis

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## **Abstract**

To optimize the efficiency of the ileocolic anastomosis following a right hemicolectomy, several variations of the surgical technique have been tested within studies. These include performing the anastomosis intra- or extracorporeally or performing a stapled or hand-sewn anastomosis. Among the least studied techniques is the parameter of the configuration of the two stumps (i.e. isoperistaltic or antiperistaltic) in the case of a side-to-side anastomosis. The purpose of the present study was to compare the isoperistaltic and antiperistaltic side-to-side anastomotic configuration after right hemicolectomy, by reviewing the relevant literature. High-quality literature is scarce with only three studies directly comparing the two alternatives; none of the studies revealed any significant differences in the incidence of anastomotic related complications such as leakage, stenosis or bleeding. However, there may be a trend towards an earlier recovery of intestinal function following the antiperistaltic anastomosis. In conclusion, existing data do not identify a certain anastomotic configuration (isoperistaltic or antiperistaltic) as superior over the alternative. Thus, the most appropriate approach is to master both anastomotic techniques and select between the two configurations based on each individual case scenario.

**Key Words:** Isoperistaltic side-to-side anastomosis; Antiperistaltic side-to-side anastomosis; Ileocolic anastomosis; Right Hemicolectomy

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**Core Tip:** This review aimed to assess and compare two side-to-side anastomotic configurations - isoperistaltic and antiperistaltic - following a right hemicolectomy, by reviewing the relevant literature. The currently published literature cannot identify a certain anastomotic configuration (isoperistaltic or antiperistaltic) as superior over the

other. Thus, the most appropriate approach is to master both anastomotic techniques and select between the two configurations based on each individual case scenario.

## **INTRODUCTION**

Colorectal cancer is one of the most common cancers globally, with a continuously increasing incidence in developing countries and stabilizing trends in highly developed countries [1]. For right sided colon cancers, a right hemicolectomy represents the surgical treatment of choice [2]. Following the resection, an anastomosis is performed between the terminal ileus and the transverse colon, for example an ileocolic anastomosis, to reestablish the gastrointestinal tract continuity. Over the past two decades two major advances in the field of colon cancer surgery have been observed; firstly, the development of the laparoscopic approach and secondly, the concept of complete mesocolic excision (CME). Several studies have demonstrated superior short-term results and similar long-term oncological outcomes with the laparoscopic approach, compared to the traditional open approach [3 - 4]. Similar to the concept of total mesorectal excision for rectal tumors, Hohenberger proposed CME for the surgical treatment of colon cancer [5]. A recent meta-analysis has shown that a right hemicolectomy with CME is not inferior in terms of safety. Furthermore, this approach is associated with a greater lymph node yield, as well as better overall and disease-free survival, compared to traditional surgery [6]. However apart from colon cancer, terminal ileitis of Crohn's disease usually represents a common indication for a more limited type of resection (i.e. ileocaecal resection), which includes the affected part of the small bowel, followed by an ileocolic anastomosis [7 - 8].

Following the resection, the efficiency and functionality of the ileocolic anastomosis could definitively influence operative outcomes and patients' recovery. In the quest for optimal results, several variations of the surgical technique have been extensively tested, with studies often reporting conflicting results [9 - 11]. Some of the tested alternatives include conducting the anastomosis intra- or extracorporeally when the laparoscopic approach is followed, using a side-to-side or an end-to-end

configuration, performing a stapled or hand-sewn anastomosis <sup>[9 - 11]</sup>. Both parameters of the early postoperative period such as anastomotic related complications, time to first flatus or time to recommencing oral feeding, as well as parameters reflecting long-term results such as functional recovery of the gastrointestinal tract and post resection quality of life scores, have been commonly used as comparison end points. However, among the least studied surgical technique alternatives is the configuration of the two stumps in the case of a side-to-side anastomosis, resulting in an isoperistaltic or antiperistaltic anastomosis. The purpose of the present review was to assess and ultimately compare the two side-to-side anastomotic configurations (isoperistaltic vs. antiperistaltic) following a right hemicolectomy by reviewing the relevant literature.

### **Factors influencing the healing of the anastomosis**

An anastomotic leak represents the clinical manifestation of a failing anastomosis. With a reported prevalence ranging between 1 and 19%, it is considered the most dramatic complication following colorectal surgery <sup>[12]</sup>. Several factors negatively influencing the physiological healing of the anastomosis have been identified. For prevention and early detection, risk factors for anastomotic leakage have been classified into preoperative, tumor related, and intraoperative risk factors <sup>[13]</sup>. Table 1 displays the risk factors for anastomotic leakage which could potentially be modified preoperatively appear of the utmost importance in a clinical setting <sup>[12 - 13]</sup>. From the technical perspective, the three most important factors for mastering a bowel anastomosis include: 1) meticulous surgical technique, taking extra care to prevent hematoma formation and achieve optimal seromuscular apposition; 2) adequate blood supply of the two bowel stumps; and 3) eliminating tension onto the anastomosis <sup>[14 - 16]</sup>.

### **Types of anastomoses**

After an oncologically appropriate right hemicolectomy, a favorable operative outcome depends primarily on the efficiency of the ileocolic anastomosis. A functional,

complication-free anastomosis can guarantee an uneventful postoperative course and improved quality of life over the long-term. To identify the optimal approach, various anastomotic techniques altering several technical parameters have been proposed. In general, the anastomoses can be performed either by the use of sutures known as hand - sewn anastomoses, or by use of stapling devices known as stapled anastomoses.

Hand - sewn anastomoses can be performed with the use of various suture materials. Materials such as silk, linen, catgut and nylon were traditionally utilized for colorectal anastomosis. Generally, the use of absorbable or multi-filament sutures can increase tissue reaction and damage, without guaranteeing uneventful anastomosis healing [17]. Today, most gastrointestinal anastomoses are performed using slowly absorbable, monofilament polydioxanone sutures [17]. In earlier decades, a double-layer inverting anastomotic technique was the criterion standard for gastrointestinal anastomosis [18]. However, single-layer anastomosis became popular following favorable results reported by relevant studies [18 - 19]. More recent studies have failed to demonstrate a difference between the double and single layer technique [20 - 21]. However, a single-layer continuous anastomosis costs less and can be constructed in significantly less time, with a similar complication rate compared to the two-layer technique [22]. The dilemma between interrupted or continuous sutures arose when single-layer anastomoses became the standard of practice. As existing literature on the subject is limited and does not show obvious trends, a continuous suture may be preferable compared to interrupted sutures for creating intestinal anastomosis, since it is less time consuming and technically simpler [23 - 24].

Conversely, stapled anastomoses include the use of different types of stapling devices. These include linear, transverse and circular staplers with two and three row stapling line systems. Following the introduction of stapled colorectal anastomosis in the 1980s, both techniques (hand sewn and stapled anastomosis) have become available for the majority of surgeons. Several studies have tried to compare the two alternatives [25]. A Cochrane review conducted by Choy *et al* concluded that stapled functional end-to-end ileocolic anastomosis after right hemicolectomy is associated with overall fewer

leaks than hand-sewn anastomosis [11]. However, the difference was not considered statistically significant when the clinically significant anastomotic leaks were used as the comparison end point [11]. In general, superiority of the stapled over the hand-sewn anastomosis cannot be documented based on existing literature [26].

Irrespective of the use of sutures or stapling devices, anastomoses can be further classified based on the configuration of the two stumps, i.e. end-to-end, end-to-side and side-to-side [15]. Figure 1. Specifically for the side-to-side configuration, an additional distinction is made between isoperistaltic and antiperistaltic anastomoses, depending on the configuration and orientation of the two stumps. In the isoperistaltic variant, the peristaltic flow in both parts is towards the same normal, aboral direction (Figure 1).

## Discussion

Several technical parameters influence the final form of an intestinal anastomosis. In the case of a side-to-side anastomosis, one of these parameters is the configuration of the two bowel stumps as an isoperistaltic or an antiperistaltic configuration. To identify the optimal configuration, the relevant literature appear contaminated by the modification of additional technical parameters to the anastomotic configuration alone. The field becomes even more obscure as increased penetration of laparoscopic surgery and incorporation of CME principles in colorectal cancer surgery have notably increased heterogeneity of the comparison groups [3 – 4, 6]. Moreover, the end point of functional recovery following colonic resections - such as the time to first flatus which has been commonly used to compare two configuration alternatives - seems to be influenced by the possible presence of other confounding factors.

### Pros and cons of the different anastomotic configurations

Generally, the ideal intestinal anastomosis is an anastomosis which can be easily performed from a technical perspective, can be reproduced by surgeons without advanced surgical skills, is associated with zero complication rates such as leakage or

stenosis, and is aligned with the physiological function of the gastrointestinal tract. To date, no single technique or anastomotic form can guarantee strict adherence to these characteristics. Traditionally, a hand sewn end-to-end anastomosis has been considered the standard approach for reestablishing gastrointestinal tract continuity after a colonic resection [27]. However, the approach was associated with an increased incidence of anastomotic related complications, mainly stenosis, particularly if a notable discrepancy occurred in the luminal diameter of the two stumps and a significant prolongation of operative times [27 - 28].

After the introduction of stapling devices, a shift in surgical trends was seen from hand sewn towards stapled anastomoses [29]. A side-to-side stapled anastomosis became the new standard in anastomotic techniques as a rapid and easier alternative, while it allowed surgeons to overcome technical difficulties posed when a significant discrepancy in the luminal diameter of the two stumps was the case [30]. Increased safety due to lower anastomotic failure rates was attributed to the stapled anastomotic approach, compared to the classic hand sewn variant, at least within initially published comparative studies [28 - 29, 31 - 34]. As more colorectal cancer resections are performed laparoscopically, another surgical dilemma which has emerged is whether to perform the anastomosis intra or extracorporeally. In 2003, Casciola *et al* reported the first intracorporeal ileocolic anastomosis after a laparoscopic right hemicolectomy [35]. Generally, performing an intracorporeal anastomosis following laparoscopic right hemicolectomy appears to be associated with quicker recovery of postoperative bowel function, decreased infection rates and overall postoperative complications when compared to the extracorporeal anastomotic approach [36 - 38].

Side-to-side anastomoses are considered to have certain advantages over the end-to-end anastomoses, including better blood supply and wider diameter. In addition, the detrimental effect of increased intraluminal pressure on the healing process of an anastomosis seems to be more efficiently addressed by the side-to-side configuration [39 - 40]. A side-to-side ileocolic anastomosis appears to be the preferred anastomotic configuration by the majority of colorectal surgeons [41]. The end-to-side



ileocolic anastomotic configuration following right hemicolectomy has recently gained popularity, due to the favorable results reported from retrospective cohort studies comparing end-to-side with side-to-side anastomosis [42 – 44]. Lower leakage rates and faster recovery at the expense of increased technical difficulty were reported after end-to-side anastomosis, compared to side-to-side anastomosis [42 – 44]. Several theoretical advantages have been attributed to the end-to-side configuration. This certain configuration resembles the physiological entry point of the ileum into the cecum lumen, it results in less tissue damage, the essential for the peristalsis, luminal muscle fibers than the side-to-side anastomosis, and it has been shown to withstand higher intraluminal pressures than end-to-end anastomosis [45]. However, these results were not confirmed in the study by Kim *et al* which is the only available prospective randomized trial in the field, or by other large retrospective cohort studies [45 – 46].

A side-to-side anastomosis can be performed either with an isoperistaltic or antiperistaltic orientation of the two stumps. Figure 1. In 2005, Tewari *et al* proposed the isoperistaltic, stapled, side-to-side ileocolic anastomosis after right hemicolectomy, rather than the antiperistaltic side-to-side anastomosis which was most common at the time [47]. Despite being the most anatomical anastomotic configuration (as it is consistent with the physiological flow of the intestinal contents), a theoretical limitation of the isoperistaltic side-to-side configuration is that it requires additional mobilization to achieve adequate overlap of the two stumps. Therefore, challenges may arise in cases where the location of the anastomosis precludes such maneuvers, such as low rectal anastomoses. However, as the isoperistaltic orientation has already proven its validity in other anatomical locations such as the biliary tree, the esophagus and the stomach, hypothesizing that it could represent the optimal approach to reestablish gastrointestinal tract continuity following colonic resections appears logical [48].

Conversely, it has been postulated that the antiperistaltic orientation could reduce the incidence of postoperative ileus, since an ileocolic anastomosis could prevent the mesentery twist which the isoperistaltic variant is considered responsible for [49]. After the resection of the ileocecal valve as a part of a right hemicolectomy, reflux of

colonic contents in the terminal ileus may occur. The disruption of the physiological direction of the colonic contents flow may be associated with secondary bacterial overgrowth in the small bowel lumen [50]. The prolonged small bowel transit times attributable to this increasingly recognized syndrome appear to be more adequately prevented with antiperistaltic anastomosis [50]. This certain anastomotic orientation likely acts as a functional pseudovalvular mechanism diminishing ileocaecal reflux, and subsequently, postoperative ileus [49].

### **Comparison of isoperistaltic vs. antiperistaltic side-to-side ileocolic anastomosis**

Few studies have directly compared the two anastomotic orientations. In 2003, Tarta *et al* published a narrative review on intracorporeal anastomosis and analyzed the configuration of the anastomosis as a possible risk factor for leakage [51]. The authors concluded that there was no difference in anastomotic breakdown when isoperistaltic anastomoses were compared to antiperistaltic anastomoses. Nevertheless, studies included in the review utilized different surgical techniques depending on the configuration type (i.e. the isoperistaltic orientation was achieved with stapled and hand sewn intracorporeal anastomoses, while the antiperistaltic anastomoses were totally stapled). To our knowledge, only three studies have directly compared the isoperistaltic and antiperistaltic orientation for ileocolic anastomoses.

The first was a study by Matsuda *et al* [52]. The authors conducted a randomized controlled trial comparing isoperistaltic *vs* antiperistaltic stapled side-to-side ileocolic and colocolic anastomoses, for colon cancer patients (20 patients in each arm) who underwent elective curative resection. While the antiperistaltic anastomoses were totally stapled, to prevent iatrogenic stenosis of the ileum stump, study authors used a running suture to close the stapling device entry hole in the isoperistaltic anastomoses. The primary end points were anastomotic leakage, hemorrhage and stenosis rates. According to the results, <sup>1</sup>no significant differences were observed in all comparison parameters between the two groups. Specifically, anastomotic leakage was seen in two <sup>1</sup>patients of the isoperistaltic group, compared with none in the antiperistaltic group (P 0.487). One patient of the antiperistaltic group had anastomotic stenosis compared with

none of the isoperistaltic group ( $P = 1.000$ ). Median postoperative length of hospital stay was similar between the two groups ( $P = 0.313$ ). However, the study was suspended due to excess morbidity detected in the isoperistaltic group. While the study did not show any short-term differences between the isoperistaltic and antiperistaltic side-to-side anastomosis, considering that anastomotic leakage occurred only in the isoperistaltic group, study authors suggested additional modifications in the isoperistaltic anastomotic technique may be justified. This study had several limitations that must be considered; [U1] firstly the small patient sample, secondly the different anastomotic types included in the analysis (both ileocolic and colocolic anastomoses), thirdly the use of both open and laparoscopic approaches for the resections, and fourthly, the technical parameters were dissimilar in the two groups (the author used additional sutures to reinforce the antiperistaltic anastomosis than the isoperistaltic anastomosis).

The second study was the ISOVANTI trial published by Ibanez et al. [49]. This was a double-blind, randomized, prospective trial in colon cancer patients undergoing laparoscopic right hemicolectomy and isoperistaltic or antiperistaltic ileocolic anastomoses. A total of 108 patients were randomized either to isoperistaltic or antiperistaltic configuration. According to the results, no differences in surgical time, anastomotic time or postoperative complications (37.0% isoperistaltic vs. 40.7% antiperistaltic -  $P = 0.693$ ) were identified. In addition, there were no differences in postoperative ileus or anastomotic leakage rates (3.7% vs. 5.56% -  $P = 1.00$ ). However, the antiperistaltic group was associated with decreased "time to first flatus" and "time to first deposition" ( $P = 0.004$  and  $P = 0.017$ ) compared to the isoperistaltic group. In the long-term, there were no differences between the two groups at 1, 6 or 12 mo, nor in chronic diarrhea rates. The authors concluded that the isoperistaltic and antiperistaltic ileocolic anastomosis present similar results in terms of performance, safety and functionality.

The third study by Zhang et al [53] retrospectively reviewed 214 consecutive patients who underwent laparoscopic right colectomy, while the gastrointestinal tract continuity was reestablished either by an isoperistaltic side-to-side anastomosis or an

antiperistaltic side-to-side anastomosis. According to the results, the two anastomotic configurations proved similar in all short-term comparison categories, for example operating time, intraoperative bleeding, length of resected intestine, number of harvested lymph nodes, length of incision, time to first flatus, time to first defecation, postoperative complications, and length of hospital stay. Similarly, at a median follow-up time of 35.6 mo, there were no differences in regard to the long-term outcomes. The authors concluded that both configurations are safe, and are associated with similar short- and long-term outcomes. Despite the fact that the study by Zhang *et al* has the [U2] largest sample size compared with the previous two studies, it is limited by its retrospective nature. However, it is the only study that assessed oncological outcomes following the different anastomotic orientations.

Relevant high-quality data in the literature are scarce to draw definite conclusions about the optimal anastomotic configuration. None of the three aforementioned studies reported any significant differences between the two alternatives, regarding incidence of anastomotic related complications such as leakage, stenosis or bleeding [49, 52 - 53]. There might be a trend towards an earlier recovery of intestinal function following the antiperistaltic anastomosis, however, the small patient sample and lack of statistical significance render solid conclusions inappropriate. High quality prospective randomized trials are needed to fully elucidate the field for optimal anastomotic configuration after a right hemicolectomy.

## **CONCLUSION**

In conclusion, the existing data do not highlight a certain anastomotic configuration - for example isoperistaltic or antiperistaltic - as superior over the other. Thus, the most appropriate approach is to master both anastomotic techniques and select between the two configurations based on each individual case scenario.

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### PRIMARY SOURCES

- 1

Matsuda, Akihisa, Masao Miyashita, Satoshi Matsumoto, Nobuyuki Sakurazawa, Goro Takahashi, Marina Yamada, and Eiji Uchida. "Isoperistaltic versus antiperistaltic stapled side-to-side anastomosis for colon cancer surgery: a randomized controlled trial", Journal of Surgical Research, 2015.

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Jon M. Burch. "Single-Layer Continuous Versus Two-Layer Interrupted Intestinal Anastomosis : A Prospective Randomized Trial", Annals of Surgery, 06/2000

21 words — 1%

Crossref
- 5

Min Hyun Kim, Sung Il Kang, Jung Rae Cho, Jeehye Lee, In Jun Yang, Jung Wook Suh, Heung-Kwon Oh, Duck-Woo Kim, Sung-Bum Kang. "Objective recovery time with end-to-side versus side-to-side anastomosis after laparoscopic right hemicolectomy for colon cancer: a randomized controlled trial", Surgical Endoscopy, 2021

20 words — 1%

Crossref



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6 Pontus Gustafsson, Pia Jestin, Ulf Gunnarsson, Ulrik Lindforss. "Higher Frequency of Anastomotic Leakage with Stapled Compared to Hand-Sewn Ileocolic Anastomosis in a Large Population-Based Study", World Journal of Surgery, 2015 19 words — 1%  
Crossref

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7 Mingguang Zhang, Zhao Lu, Xiyue Hu, Haitao Zhou, Zhaoxu Zheng, Zheng Liu, Xishan Wang. "Comparison of the short-term outcomes between intracorporeal isoperistaltic and antiperistaltic totally stapled side-to-side anastomosis for right colectomy: A retrospective study on 214 consecutive patients", Surgery Open Science, 2022 15 words — < 1%  
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8 [www.ncbi.nlm.nih.gov](http://www.ncbi.nlm.nih.gov) 13 words — < 1%  
Internet

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9 Juliette C. Slieker, Freek Daams, Irene M. Mulder, Johannes Jeekel, Johan F. Lange. "Systematic Review of the Technique of Colorectal Anastomosis", JAMA Surgery, 2013 12 words — < 1%  
Crossref

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10 [iopscience.iop.org](http://iopscience.iop.org) 12 words — < 1%  
Internet

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