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ANASTOMOTIC LEAKAGE AND STOMA FORMATION IN LEFT-SIDED COLORECTAL SURGERY: RISK STRATIFICATION AND SURGICAL DECISION-MAKING - A REVIEW OF CURRENT EVIDENCE

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ABSTRACT

The surgical approach following left-sided resection of the colon and rectum remains a significant intraoperative challenge in colorectal surgery. One of the most severe complications of restoring gastrointestinal continuity is anastomotic leakage (AL). This narrative review summarizes current data on risk factors for AL and criteria supporting the choice between primary anastomosis, primary anastomosis with a diverting stoma, and Hartmann's procedure. The literature search was conducted in the PubMed database (August - September 2026) and supplemented with current guidelines from the WSES, ACPGBI, ASCRS, and EAES/SAGES. Analysis of the available data indicates that the significance of individual risk factors depends on the patient population and the type of resection performed, and that no individual factor should determine the choice of surgical strategy. The strongest evidence supporting diverting stoma formation concerns low anterior resection for rectal cancer. In perforated diverticulitis and malignant obstruction, primary anastomosis appears to be a safe option in stable, appropriately selected patients, while Hartmann's procedure is preferred for critically ill patients or those with significant comorbidities. Current guidelines from surgical societies provide valuable guidance, although their recommendations are not fully consistent. The choice of operative strategy should therefore be supported by an individualised, multifactorial risk assessment that considers both the likelihood of AL and the anticipated consequences of each surgical approach.

KEYWORDS

Anastomotic Leakage, Colorectal Surgery, Diverting Stoma, Primary Anastomosis, Hartmann's Procedure

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1. Introduction

Anastomotic leakage (AL) remains one of the most severe complications following colorectal resection with restoration of gastrointestinal tract. Its risk varies depending on several factors, including the location of the anastomosis and the characteristics of the patient population. The reported incidence of AL following colorectal surgery ranges from approximately 1.5% to 28%, with higher rates observed for anastomoses located in the distal segments of the gastrointestinal tract (Gené-Škrabec et al., 2023). This variability also reflects differences in the definition of AL and the diagnostic methods employed (Zarnescu et al., 2021).

According to the definition proposed by the International Study Group of Rectal Cancer for anastomotic leakage following anterior rectal resection, AL is defined as a defect of the integrity of the intestinal wall at the anastomosis, resulting in abnormal communication between the intra- and extraluminal compartments (Rahbari et al., 2010). Moreover, a pelvic abscess located in close proximity to the anastomosis should also be considered an anastomotic leak. Rahbari et al. also proposed a three-grade clinical classification based on the impact of AL on patient management. Grade A leaks do not require active treatment, Grade B leaks require therapeutic intervention without the need for relaparotomy, while Grade C leaks require relaparotomy.

Anastomotic leakage is associated with increased postoperative morbidity and mortality, the need for additional interventions, and prolonged hospitalisation (Oliveira et al., 2023; Zarnescu et al., 2021). It may also cause long-term consequences, which particularly affect patients undergoing surgery for colorectal cancer. A meta-analysis of 56 studies showed an increased risk of local recurrence among patients with rectal cancer who developed AL (HR 2.06; 95% CI 1.53-2.76), whereas no statistically significant relationship was observed in patients with colon cancer (HR 1.68; 95% CI 0.62-4.53). Furthermore, AL was associated with worse overall and disease-free survival of patients with both rectal and colon cancer (Yang et al., 2026).

Anastomotic leakage also imposes a substantial economic burden. A systematic review by Nijssen et al. (2024) showed that AL generates additional costs related, among other factors, to readmissions, intensive care unit treatment, and the need for further interventions.

The risk of anastomotic leakage is multifactorial. A meta-analysis involving 115,462 patients undergoing colectomy for colon cancer reported AL in 3.4% of cases (J. He et al., 2023). A higher incidence

of this complication was associated with factors such as male sex, higher BMI, concomitant pulmonary disease, higher ASA class, emergency surgery, open surgery and the type of resection performed. However, evidence regarding the relationship between age or cardiovascular disease and AL remained inconclusive. These findings indicate that assessment of AL risk should account for the coexistence of multiple factors related to the patient, the disease indicating the need for surgery, and the course of treatment.

Risk assessment becomes particularly important in emergency surgery. Obstruction or perforation due to colorectal cancer may lead to fluid and electrolyte imbalances, peritonitis, sepsis and haemodynamic instability, potentially limiting the feasibility of a safe anastomosis. In such circumstances, the choice of surgical management should primarily take into account the patient's physiological condition, comorbidities, the location of the disease process, and the intraoperative assessment of whether a safe anastomosis can be performed (Pisano et al., 2018). Similarly, in perforated diverticular disease, the choice of surgical strategy depends on the patient's clinical condition and comorbidity burden. WSES guidelines recommend Hartmann's procedure for critically ill patients with diffuse peritonitis and for selected patients with multiple comorbidities (Sartelli et al., 2020). In clinically stable patients without significant comorbidities, however, resection with primary anastomosis, with or without a diverting stoma, may be considered.

The choice between resection with primary anastomosis, primary anastomosis with a diverting stoma, and Hartmann's procedure remains a significant decision-making challenge in colorectal surgery. Despite the identification of numerous risk factors and the development of predictive models, there is no universal algorithm that allows for an unambiguous selection of the optimal surgical strategy for every patient. The decision should therefore incorporate the individual risk of anastomotic leakage, the patient's clinical condition and the circumstances of the procedure. In emergency settings, the indication for surgery and intraoperative findings are also particularly relevant (Pisano et al., 2018; Sartelli et al., 2020; Zarnescu et al., 2021).

The aim of this review is to summarise current evidence on risk factors for anastomotic leakage in left-sided colorectal resections and to evaluate criteria that may support the choice between primary anastomosis, primary anastomosis with a diverting stoma, and Hartmann's procedure. The first part of this review discusses patient-, disease- and treatment-related factors that may influence the risk of AL, whereas the second part analyses current evidence on the choice of surgical strategy depending on the individual risk profile.

2. Methodology

This study was conducted as a narrative literature review based on searches of the PubMed database performed between August and September 2026. The literature search used the following keywords and their combinations: "anastomotic leak", "anastomotic dehiscence", "colorectal surgery", "risk factors", "diverting stoma", "ileostomy", and "Hartmann's procedure". For the section addressing surgical strategy, the search was supplemented by current guidelines and consensus documents from surgical societies, including WSES, ACPGBI, ASCRS, and EAES/SAGES, concerning elective and emergency colorectal surgery.

The search was restricted to publications in English. No formal restriction on publication date was applied. All articles meeting the substantive eligibility criteria were included. Recent literature was preferred, while older publications were retained when considered relevant to the scope of the review.

The selected literature comprised primary studies (randomised clinical trials, cohort studies and case-control studies), systematic reviews and meta-analyses, as well as guidelines and position statements from surgical societies. Articles were considered relevant if they involved adult patients undergoing left-sided colonic or rectal resection and evaluated either risk factors for anastomotic leakage or criteria relevant to the choice between primary anastomosis without diversion, primary anastomosis with a diverting stoma and Hartmann's procedure. Studies concerning anastomoses unrelated to colorectal surgery, including anastomoses of the upper gastrointestinal tract and small intestine anastomoses, were excluded from the review. Ultimately, 42 literature references were included in the study, comprising 35 primary studies, systematic reviews and meta-analyses, and 7 guidelines or consensus documents from surgical societies (WSES, ACPGBI, ASCRS and EAES/SAGES).

3. Risk factors for anastomotic leakage in left-sided colorectal surgery

Available evidence confirms the multifactorial nature of anastomotic leakage. Clinical risk assessment should consider patient-related factors, disease- and treatment-related factors, technical and surgical factors, as well as perioperative factors and postoperative predictors. The strength of the reported associations with AL and the quality of supporting evidence vary among individual factors, while their significance may also depend on the population studied and the type of resection performed. Therefore, the interpretation of the evidence should account for both multivariable analyses and the applicability of their findings to the specific clinical setting.

3.1. Patient-related factors

Among patient-related factors, smoking and alcohol consumption have been repeatedly investigated. In a prospective study by Sørensen et al. (1999), involving 333 patients undergoing surgery for colorectal cancer, smoking was associated with a higher risk of AL (RR 3.18; 95% CI 1.44-7.00), as was the consumption of more than 35 units of alcohol per week (RR 7.18; 95% CI 1.20-43.01). In the study by Richards et al. (2011), active smoking remained independently associated with AL (OR 3.68; 95% CI 1.38-9.82), as did the presence of distant metastases (OR 3.43).

Comorbidity burden and nutritional status may also be clinically relevant. In a multicentre cohort study by Tian et al. (2017), which included 11,397 patients, a Charlson Comorbidity Index (CCI) ≥ 3 was associated with a higher risk of AL compared with a CCI = 0 (OR 1.82; 95% CI 1.24-2.69), and each additional CCI point was associated with an increased risk (OR 1.10 per point). In a multicentre case-control study by Ramos Rodriguez et al. (2024), preoperative hypoalbuminaemia < 3.5 g/dL was strongly associated with AL (OR 22.2; 95% CI 11.5-42.9), as were age ≥ 65 years (OR 2.48) and AJCC stage III-IV (OR 2.71). In a retrospective cohort limited to emergency procedures, preoperative albumin levels were significantly lower in patients who developed AL (3.63 vs 4.01 g/dL; $p = 0.046$) (Astorga Guardado et al., 2026).

Obesity is another frequently investigated risk factor, although its relevance may vary according to the method used for its assessment. Cakir et al. (2015), in an analysis of 564 patients undergoing resection for colon cancer, demonstrated an independent association between visceral obesity, assessed by computed tomography, and AL (OR 2.3; 95% CI 1.0-5.4; $p = 0.05$), whereas BMI alone was not an independent risk factor. In contrast, a meta-analysis by J. He et al. (2023) demonstrated associations between AL and both BMI and obesity, as well as with male sex, chronic lung disease and ASA class $\geq$ III.

More recent evidence also suggests the possible role of preoperative antithrombotic therapy. In the multicentre CONDOR cohort study (Cats et al., 2026), involving 1,346 patients, antithrombotic treatment was independently associated with AL (OR 2.10; 95% CI 1.27-3.44). This association was observed primarily for non-vitamin K antagonist oral anticoagulants and vitamin K antagonists, rather than antiplatelet agents or heparin. As this finding derives from a single study, it requires confirmation in further analyses and should not independently determine the choice of surgical strategy.

3.2. Disease- and treatment-related factors

The significance of individual risk factors also depends on the clinical indication for surgery and the treatment administered. In a multicentre analysis by Park et al. (2013), involving 1,609 patients undergoing rectal resection, independent factors associated with AL in the subgroup without a diverting stoma included low tumour location, preoperative chemoradiotherapy and perioperative blood transfusion, as well as male sex - a patient characteristic included in the same model. In a study by Midura et al. (2015), preoperative chemotherapy and steroid therapy were also associated with a higher risk of AL.

In a study by Zhang et al. (2017), which included 319 patients with mid- and low-rectal cancer treated surgically without a diverting stoma, independent factors associated with AL were tumour location ≤ 7 cm from the anal verge and preoperative chemoradiotherapy, as well as male sex and diabetes, which were patient-related characteristics included in the same model. The authors also described an association between K-ras mutations and AL (OR 2.544; 95% CI 1.210-5.348). Given the limited available evidence, this finding concerning the molecular tumour profile should be regarded as preliminary and requires confirmation in further studies.

Emergency surgery represents a particularly significant clinical context. A meta-analysis by J. He et al. (2023) demonstrated an association between emergency surgery and an increased risk of AL. In a retrospective study by Brunner et al. (2024), examining surgery for colonic perforation, the AL rate was 12% and the

presence of comorbidities was its only independent predictor. In a study by Liu et al. (2025), which included patients with obstruction caused by left-sided colon cancer, AL occurred in 10.6% of patients. Multivariable analysis identified BMI, albumin concentration, and ileocecal valve incompetence as factors associated with AL. These results emphasise that in emergency situations the risk depends both on the patient's comorbidity burden and on the nature of the acute disease process.

3.3. Surgical and technical factors

Surgical technique and intraoperative factors may also contribute to the risk of AL. In an analysis by Midura et al. (2015), based on the ACS NSQIP database and covering 13,684 colectomies, independent factors associated with AL included an open rather than laparoscopic approach (OR 1.71; 95% CI 1.27-2.31) and an operative duration exceeding 3 hours (OR 1.50; 95% CI 1.19-1.90). In the same study, loop ileostomy was associated with a lower risk of AL (OR 0.55; 95% CI 0.31-0.97), although the observational nature of the data precludes causal inference.

The relevance of prolonged operative time is further supported by a retrospective cohort study by Buniatov et al. (2026), comprising 672 patients, in which an operative duration of ≥ 300 minutes remained independently associated with AL (OR 3.6). Intraoperative hypothermia, blood loss > 500 mL and the use of noradrenaline were associated with AL in univariable analysis but did not remain significant after multivariable adjustment. In the same model, ASA class III/IV remained an independent predictor (OR 3.8; 95% CI 1.3-11.3), representing a patient-related factor assessed alongside technical variables.

The technique used for rectal transection may also be significant. In a study by Ito et al. (2008), involving 180 patients undergoing laparoscopic rectal resection, the use of three or more linear stapler firings was independently associated with AL (OR 4.6; 95% CI 1.1-19.2; $p = 0.03$). A similar finding was reported by Park et al. (2013), whose study identified multiple stapler use as an independent predictor of AL in the subgroup of patients without a diverting stoma.

Intraoperative assessment of anastomotic perfusion is an example of an intervention that may modify the surgical plan. In the prospective multicentre PILLAR II study (Jafari et al., 2015), which included 139 patients undergoing left-sided colectomy or anterior resection, the use of indocyanine green fluorescence angiography led to a change in the surgical plan in 7.9% of patients. In 11 patients, the bowel transection level was altered based on perfusion assessment, and no AL was observed in this group. The overall AL rate in the study population was 1.4%. However, in the absence of a control group, the magnitude of any preventive effect cannot be determined from these findings.

3.4. Perioperative factors and postoperative predictors

Not all factors associated with AL can be used to select a surgical strategy before the anastomosis is constructed. Some evidence concerns perioperative interventions or markers that become available only after surgery. In the randomised GRECCAR 5 trial (Denost et al., 2017), involving 469 patients with an infraperitoneal anastomosis following rectal resection for cancer, routine pelvic drainage did not reduce the rate of pelvic sepsis compared with no drainage (16.1% vs 18.0%; $p = 0.58$), nor did it significantly affect the rate of reoperation, length of hospital stay or stoma closure rate at 6 months.

In a retrospective study by Gorissen et al. (2012), including 795 patients, the use of nonsteroidal anti-inflammatory drugs (NSAIDs) during the first five days after surgery was independently associated with AL (OR 1.84; 95% CI 1.13-2.98), with this relationship observed primarily with non-selective NSAIDs. A different approach was taken by Z.-H. He et al. (2026), who incorporated elevated postoperative procalcitonin and decreased haemoglobin levels into a predictive model designed to facilitate early identification of AL. These laboratory parameters may therefore have prognostic value in the postoperative setting but are not applicable to preoperative risk assessment.

3.5. From individual risk factors to cumulative risk assessment

Overall, the available evidence indicates that AL cannot be attributed to any single factor. Its occurrence reflects the combined effects of patient characteristics, the nature of the underlying disease, prior treatment and the technical conditions of surgery. Moreover, some factors identified in one study are not consistently confirmed in other populations, and the magnitude of the observed associations may vary according to the type of resection.

From a clinical perspective, factors that can be identified before or during surgery are particularly relevant, as they support the assessment of anastomotic safety and the decision regarding diversion. However,

no single statistically significant risk factor should be regarded as an independent indication for stoma formation. Therefore, a multifactorial approach should take into account both the likelihood of AL and the anticipated consequences of its occurrence. Such an individualised risk assessment provides the clinical basis for selecting the most appropriate operative strategy.

4. Selection of the surgical strategy according to the risk of anastomotic leakage

The available options include primary anastomosis without diversion, primary anastomosis with a diverting stoma and, in selected circumstances, Hartmann's procedure. Evidence supporting these strategies derives from different patient populations and clinical settings, which should be considered when interpreting the available findings.

4.1. Primary anastomosis and the role of a diverting stoma

Primary anastomosis preserves gastrointestinal continuity and avoids the complications of a stoma and the need for subsequent reconstructive surgery. However, the decision to perform it should take into account anastomotic safety in the specific clinical setting. When the risk of leakage is increased, one possible strategy is the creation of a diverting stoma. This strategy should be clearly distinguished from Hartmann's procedure, in which no anastomosis is created.

The strongest evidence supporting diversion comes from studies on low anastomoses following rectal resection. In a multicentre randomised trial by Matthiessen et al. (2007), which included 234 patients undergoing low anterior resection for rectal cancer, symptomatic AL occurred in 10.3% of patients with a diverting stoma and 28.0% of those without diversion. Urgent reoperation was required in 8.6% and 25.4% of patients, respectively. Eligible patients had an anastomosis ≤ 7 cm from the anal verge, a negative intraoperative air leak test, complete tissue rings after circular stapling and no significant intraoperative complications. These findings were confirmed in a meta-analysis by Phan et al. (2019), which involved eight randomised trials on low anterior resection for rectal cancer. The rate of AL was significantly lower with a diverting stoma than without diversion (6.3% vs 18.3%; RR 0.36; 95% CI 0.24-0.54). A similar association was observed for reoperation (5.9% vs 16.7%; RR 0.40; 95% CI 0.26-0.60). However, no significant difference was found in mortality related to leakage.

These findings indicate a clinical benefit of diverting stoma formation in appropriately selected patients with a low anastomosis after rectal resection. Nevertheless, they should not be directly generalised to all left-sided colonic and rectal resections. Both the trial by Matthiessen et al. (2007) and the meta-analysis by Phan et al. (2019) concern low anterior resection for rectal cancer. Evidence supporting routine diversion in other left-sided resections is more limited.

An additional tool that may support the decision to form a diverting stoma is the intraoperative assessment of anastomotic perfusion using indocyanine green (ICG) fluorescence angiography. The 2023 European Association for Endoscopic Surgery (EAES) consensus issued a strong recommendation indicating that ICG-based tissue perfusion assessment during colorectal surgery reduces the risk of anastomotic leakage (Cassinotti et al., 2023). In a study cited in the consensus, a protective stoma was created in 44% of patients in the ICG group compared with 54% in the control group, suggesting that reliable intraoperative perfusion assessment may reduce stoma formation without compromising anastomotic safety. The SAGES/EAES guidelines published in 2025 expanded these recommendations, supporting the use of ICG before construction of a left-sided colorectal anastomosis for both benign and malignant disease to improve anastomotic integrity. This strong recommendation, based on evidence of moderate quality, also applies to patients in whom a diverting stoma is planned (Calabrese et al., 2025). Therefore, incorporating ICG perfusion assessment into the decision-making process does not replace risk-factor assessment but may provide a useful intraoperative adjunct.

Accordingly, the presence of any single AL risk factor should not automatically lead to formation of a diverting stoma. The location of the anastomosis, the cumulative risk profile and the anticipated consequences of leakage are all relevant. The available evidence most strongly supports diversion for low rectal anastomoses in patients at increased risk of AL, whilst in other situations the decision requires individualised assessment.

4.2. When should primary anastomosis be avoided? The role of Hartmann's procedure

When the risk associated with anastomosis is considered unacceptably high, Hartmann's procedure could be one of the alternatives. Unlike a diverting stoma, it does not protect an existing anastomosis but avoids its construction. This distinction is crucial in emergency surgery, where the choice of approach depends on the intraoperative assessment of whether a safe anastomosis can be achieved, as well as on the patient's physiological status and the severity of the disease.

Most of the data comparing primary anastomosis with Hartmann's procedure relate to perforated diverticulitis with purulent or faecal peritonitis. In the DIVERTI trial, 102 patients with Hinchey grade III or IV diverticulitis were randomised to either Hartmann's procedure or resection with primary anastomosis and a diverting stoma (Bridoux et al., 2017). No significant difference in mortality was observed between the groups. However, at 18 months, gastrointestinal continuity had been restored in 96% of patients after primary anastomosis compared with 65% after Hartmann's procedure. These results should be interpreted in the context of patient selection and should not be used to support routine primary anastomosis in all patients with diffuse peritonitis.

Bezerra et al. (2020) provided a more comprehensive assessment of both strategies in a systematic review and meta-analysis involving adults undergoing emergency surgery for perforated diverticulitis. Due to the risk of selection bias, the results of randomised trials and observational studies were analysed separately. In the analysis restricted to randomised clinical trials, no significant differences were found between primary anastomosis and Hartmann's procedure in terms of 30-day mortality (OR 0.83; 95% CI 0.32-2.19), overall morbidity (OR 0.95; 95% CI 0.62-1.44) or severe morbidity following emergency surgery (OR 0.77; 95% CI 0.43-1.31). Primary anastomosis, however, was associated with a lower risk of failure to undergo reconstructive surgery (OR 0.30; 95% CI 0.11-0.81) and with lower overall morbidity (OR 0.31; 95% CI 0.15-0.64) and severe morbidity (OR 0.20; 95% CI 0.06-0.67) related to restoration of gastrointestinal continuity. Observational studies additionally suggested lower mortality and morbidity after primary anastomosis, yet the authors emphasised differences in the characteristics of patients selected for each procedure, and the resulting risk of selection bias. Thus, conclusions regarding the safety of both strategies should rely primarily on randomised evidence.

Similar conclusions were reported in a meta-analysis by Lambrichts et al. (2020), which included four randomised controlled trials (RCTs) and ten observational studies, involving a total of 1,066 patients with Hinchey grade III-IV diverticulitis. In the randomised trials, primary anastomosis was associated with a higher probability of subsequent restoration of gastrointestinal continuity (OR 2.62; 95% CI 1.29-5.31) and a lower risk of complications following reconstructive surgery (OR 0.33; 95% CI 0.16-0.69). However, no significant differences were observed in mortality, morbidity or the frequency of reinterventions following the primary operation. Data on a direct comparison of primary anastomosis with and without the creation of a diverting stoma remained limited.

Long-term evidence is provided by the three-year follow-up of the DIVA arm of the LADIES trial (Edomskis et al., 2022). The analysis included 119 of the 130 patients originally randomised: 57 in the primary anastomosis group and 62 in the Hartmann's procedure group. At 36 months, the proportion of patients without a stoma was significantly higher after primary anastomosis than after Hartmann's procedure (92% vs 81%; HR 2.326; 95% CI 1.538-3.517). No significant differences were found in cumulative morbidity (36% vs 48%) or mortality (11% vs 11%). However, parastomal hernias were more frequent after Hartmann's procedure (16 % vs 2%) and the total length of hospitalisation during the follow-up period was longer.

The eligibility criteria for the LADIES trial are essential for the interpretation of these findings. The study included adults with clinical symptoms of generalised peritonitis and suspected perforated diverticulitis, while patients with preoperative shock requiring inotropic support and those receiving chronic steroid therapy at a dose of at least 20 mg/day were excluded. In case of primary anastomosis, the decision to create an ileostomy was left to the surgeon. Consequently, the results of the three-year follow-up support the use of primary anastomosis in appropriately selected patients who are haemodynamically stable and immunocompetent. However, it should not be regarded as a universal alternative to Hartmann's procedure (Edomskis et al., 2022).

These findings are consistent with the WSES guidelines (Sartelli et al., 2020). Hartmann's procedure is recommended for patients with diffuse peritonitis who are in a critical condition and for selected patients with multiple comorbidities. In clinically stable patients without comorbidities, however, resection with primary anastomosis, with or without the creation of a diverting stoma, may be considered. Therefore, the choice between these strategies should reflect anastomotic safety in the individual clinical context rather than solely the diagnosis of perforated diverticulitis.

4.3. Malignant obstruction and perforation

Emergency surgery for obstruction or perforation associated with cancer requires a distinct approach. In uncomplicated left-sided malignant obstruction, the WSES guidelines recommend resection with primary anastomosis as the preferred strategy in patients without additional risk factors (Pisano et al., 2018). However, in patients at high surgical risk Hartmann's procedure is preferred. The authors also emphasise the limited quality of direct comparative evidence and the importance of individualised surgical assessment.

Similarly, the ACPGBI guidelines (Miller et al., 2021) state that management of left-sided malignant obstruction depends largely on the patient's physiological condition, comorbidities and the feasibility of safe anastomosis. Possible strategies include resection with primary anastomosis, with or without the creation of a diverting stoma, Hartmann's procedure and temporary bowel decompression.

This approach is also reflected in the ASCRS (American Society of Colon and Rectal Surgeons) guidelines for colon cancer (J. D. Vogel et al., 2022). For resectable left-sided colon cancer presenting with obstruction, the authors recommend individualised selection among endoscopic stenting, diverting colostomy followed by delayed resection and initial oncologic resection. The decision should take into account the patient's condition and comorbidity burden, as well as institutional expertise. This is a strong recommendation based on moderate-quality evidence.

Dutch cohort studies cited in the ASCRS guidelines confirm the benefits of initial decompression via colostomy (J. D. Vogel et al., 2022). Compared with stenting, diverting colostomy was associated with higher rates of subsequent laparoscopic resection (57% vs 9%) and primary anastomosis (88% vs 41%), as well as lower incidence of permanent stoma (22% vs 42%) and lower 90-day mortality (1.7% vs 7.2%). Three-year overall survival was also higher in the group initially treated with colostomy (79% vs 73%).

Perforated colon cancer represents a separate clinical scenario. According to ASCRS guidelines, oncologic resection remains the mainstay of treatment, while the possibility of primary anastomosis depends on the patient's condition and intraoperative findings (J. D. Vogel et al., 2022). Primary anastomosis may be considered in stable patients when contamination of the surgical field is limited and tissue quality is satisfactory, with a diverting stoma if advisable. In the presence of diffuse contamination or peritonitis, primary anastomosis should be avoided and a permanent stoma created. Self-expanding metal stent placement is contraindicated in case of perforation.

In selected patients with malignant obstruction, decompressive strategies may allow definitive bowel resection to be postponed until the patient's condition stabilises. A network meta-analysis by McHugh et al. (2024), comprising 19 randomised or propensity score-matched studies, compared emergency resection, self-expanding metal stenting and diverting stoma as strategies preceding definitive treatment. Both stenting and diverting stoma were associated with a lower risk of permanent stoma compared with immediate resection. Furthermore, primary anastomosis was achieved more frequently following stenting. However, direct evidence comparing individual bridge-to-surgery strategies remains limited.

4.4. Clinical burden associated with stoma formation

The potential benefit of creating a diverting stoma must be considered in relation to the morbidity associated with the stoma itself. This is particularly crucial for ileostomy. In a systematic review and meta-analysis by Borucki et al. (2021), which included 22 studies and 19,485 patients undergoing resection for colon or rectal cancer, the incidence of dehydration was 9.0% and the presence of a diverting ileostomy was associated with more than a threefold increase in the risk of this complication (RR 3.37; 95% CI 2.30-4.95). Other adverse outcomes included unplanned hospitalisations, acute kidney injury, deterioration of renal function during follow-up, and potential delays in adjuvant treatment.

In a meta-analysis by I. Vogel et al. (2022), which included 71 studies and 82,451 patients after ileostomy formation, 20% of patients required readmission within 30 days of surgery, whilst in 6% this was due to dehydration, the most common stoma-related cause of readmission. These findings indicate that a diverting stoma formation is not a procedure without its own risks, and its potential benefits should be balanced against possible complications.

The need to evaluate the benefits and burdens associated with a diverting stoma is also reflected in the ASCRS guidelines on stoma surgery (Davis et al., 2022). According to these guidelines, a loop ileostomy or loop colostomy provides effective temporary fecal diversion (strong recommendation, moderate quality of evidence), while early closure of a protective ileostomy may be considered in selected low-risk patients with an intestinal anastomosis and no clinical evidence of leakage (weak recommendation, moderate quality of evidence), potentially reducing the duration of exposure to stoma-related complications.

The guidelines also emphasise the importance of appropriate perioperative care for patients with a newly created ileostomy. The implementation of a standardised care pathway, including patient education and monitoring of fluid balance after discharge from the hospital, was associated in some studies with fewer readmissions due to dehydration. However, the results were inconclusive, which was reflected in the low strength of the recommendation (Davis et al., 2022).

When considering a temporary ileostomy, the possibility that it may not subsequently be reversed should also be taken into account. In a meta-analysis by F. He et al. (2024), which included 13 studies and 3,026 patients after sphincter-preserving surgery for rectal cancer, a higher risk of failure to close a temporary ileostomy was observed in older patients, men, patients with ASA $\geq$ III, comorbidities or distant metastases. These findings should be considered when assessing the potential benefits and risks of diverting stoma formation.

5. Discussion

Integrating AL risk factors with evidence on individual surgical strategies confirms that decisions regarding restoration of the gastrointestinal tract should be individualised for each patient. Available studies identify numerous factors associated with an increased risk of leakage. However, none of them constitutes an independent indication for creating a diverting stoma or avoiding primary anastomosis. Their coexistence, the clinical context and the intraoperative assessment of the feasibility of safely performing the anastomosis are therefore essential.

Available evidence on the choice of surgical strategy varies depending on the type of procedure and clinical setting. The benefits of a diverting stoma are most clearly established in patients undergoing low anterior resection. In this population, randomised clinical trials and their meta-analyses have shown that diversion is associated with lower rates of anastomotic leakage and reoperation (Matthiessen et al., 2007; Phan et al., 2019). However, these studies concern a strictly defined group of patients. Therefore, their results should not be directly generalised to all left-sided colonic and rectal resections. In perforated diverticulitis, Hartmann's procedure continues to play an important role in critically ill patients or those with substantial comorbidity. In appropriately selected, stable patients, available evidence indicates that primary anastomosis may be a safe alternative (Bridoux et al., 2017; Lambrichts et al., 2020; Sartelli et al., 2020; Edomskis et al., 2022).

The potential consequences of stoma formation also remain relevant during the decision-making process. Although diversion may reduce the clinical consequences of anastomotic leakage in selected patients, a stoma is associated with risks including dehydration, hospital readmission, renal dysfunction and failure to undergo the planned reversal procedure (Borucki et al., 2021; I. Vogel et al., 2022; F. He et al., 2024). These complications should be considered when selecting the surgical strategy.

Accordingly, current guidelines do not support a single, standardised management algorithm. Although the recommendations from WSES, ACPGBI and ASCRS take into account the patient's physiological condition, comorbidities, the indication for surgery and intraoperative assessment, they relate to different patient groups and clinical scenarios and vary in the detailedness of their recommendations (Pisano et al., 2018; Sartelli et al., 2020; Miller et al., 2021; J. D. Vogel et al., 2022). Nevertheless, they outline a general approach to the choice among primary anastomosis without diversion, primary anastomosis with a diverting stoma, and Hartmann's procedure.

Based on the current state of knowledge, factors relevant to an individualised assessment of anastomotic leakage risk can therefore be identified. However, they are insufficient to determine the optimal surgical strategy for each patient. This issue remains an important area for further research.

6. Conclusions

This review indicates that the safety of intestinal anastomosis in colorectal surgery depends on a complex set of clinical circumstances specific to each patient, rather than a single, easily measurable variable. Relevant factors include patient characteristics, the underlying disease, oncologic treatment, operative technique, and intraoperative findings, while postoperative parameters may contribute to the early identification of AL. It is the combined, rather than isolated, contribution of these factors that determines the actual risk of anastomotic leakage.

Therefore, the choice between primary anastomosis without diversion, primary anastomosis with a diverting stoma, and Hartmann's procedure should be based on an individualised risk assessment that considers both the probability of leakage and the anticipated clinical consequences of each available strategy,

including potential complications related to the diverting stoma itself. Current guidelines from surgical societies, such as the WSES, ACPGBI and ASCRS, provide a useful framework for decision-making but do not support a single universal algorithm because they differ in scope, target populations, and strength of recommendations.

Consequently, the surgical decision continues to rely largely on clinical experience and the intraoperative assessment of anatomical and technical conditions. Further research into methods for evaluating cumulative risk could facilitate the selection of the most appropriate management strategy and reduce variation in clinical practice. Until then, a reliable, multifactorial risk assessment remains the most important tool for supporting the choice of surgical strategy in colorectal surgery.

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