DOI: 10.15386/cjmed-420

OPERATOR-RELATED RISK FACTORS OF ANASTOMOTIC LEAKS AFTER COLORECTAL SURGERY: AN UP-TO-DATE

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Abstract

Digestive fistulas are a major complication after digestive surgery. Anastomotic leakage increases the hospitalization time, the prognosis and survival rate after colorectal surgical interventions.

The factors involved are either systemic (determined by the patients' co-morbidities), or local (vicious surgical technique or the injuries produced by the disease that requires the anastomosis). Although there are many studies regarding the risk factors of anastomotic leaks, there is no consensus for the role played by each one of them in the healing process of digestive sutures. Most authors sustain that the importance of systemic factors is secondary, the main role being played by the surgeon and the local conditions of the anastomosis.

Knowledge of the risk factors can lead to new methods of reducing the incidence of anastomotic leaks by improving vascularization, limiting the tension and the duration of surgery, and by new surgical techniques used for digestive sutures.

Keywords: anastomotic leak, colorectal surgery, risk factors.

Introduction

Digestive fistulas are a major complication of colorectal surgery, significantly increasing the duration of hospitalization, the risk of nosocomial infections and the costs, altering the prognosis and raising by 8 to 10 times the postoperative mortality rate [1].

Due to multifactorial etiology and various theories regarding the incidence, this topic remains one of great interest to researchers. Despite progress in intensive care and the development of new surgical techniques, digestive fistula occurrence rate is quoted as being between 1.5 and 16% [2-6].

Digestive fistulas are generated by the complex interplay between the local conditions of anastomoses (which refer to the surgical technique and the local characteristics of the primary disease – neoplasic infiltration, inflammation, neoadjuvant therapy) and systemic alterations that can interfere with the digestive healing.

The essential rules for a reliable anastomosis are: ensuring a good exposure through a suitable incision, an adequate blood flow of the anastomosis, the absence of tension, minimization of septic time by means of colon preparation [7,8].

In this article we reviewed the main risk factors that can be controlled by the surgeon during the therapeutic procedure: vascularization, surgical technique, blood loss, and duration of surgery.

A. Vascularization

An adequate blood flow is essential in the healing process of the suture. A proper vascularization ensures an appropriate intake of nutrients and oxygen and allows the removal of metabolites [5].

Most often assessed by the surgeon according to her/his experience, by observing the coloration and the presence of bleeding, or by anatomical knowledge, this

Manuscript received: 25.02.2015
Received in revised form: 26.03.2015
Accepted: 02.04.2015
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method is subjective and imprecise. Bulkley argued that although it has a 90% accuracy in identifying problem cases, it can lead to excessive resection at a rate of 46% [5].

In an attempt to streamline the recognition of cases with increased risk of developing anastomotic dehiscence, studies on a variety of blood supply to the colon by angiographic methods were conducted. Thus, on a number of 17 pieces of colorectal resection, Allison et al. [7] showed differences in the distribution of vasa recta according to the analyzed segment. A 2 cm spatialization was noticed and collaterals reduced at the level of the splenic flexure and the proximal portion of the descending colon, unlike the 1 cm spatialization, with an increased number of collaterals in the ascending, transverse and sigmoid colon. In the rectum there are also differences depending on its segments with a poor vascularization in the lower portion.

In cases of left colonic or rectal malignancy, a controversial issue is that of high (at the emergence from the abdominal aorta) versus low (below the origin of left colic artery) ligation of the inferior mesenteric artery. In case of high ligation, blood supply of the distal colon is maintained by the marginal artery, potentially altering the anastomosis vascularization [8]. Hall et al., by measuring the oxygen concentration in tissues, showed that after ligation, either low or high, the concentration was significantly lower in the sigmoid colon, without any statistical differences between the two groups [9] meaning that high ligation must not be considered a risk factor for anastomotic leakage. In addition, randomized trials and experimental studies showed that high ligation of inferior mesenteric artery has a low degree of technical difficulty, allows a complete mobilization of the left colon for a tension free anastomosis, enables a complete excision of the lymph nodes and prevents potential intravascular dissemination during tumor manipulation [8-10].

Studies in the last 10 years have been directed towards the identification of ways for assessing the intestinal viability post-anastomosis. Doppler ultrasonography, laser Doppler flowmetry and measurement of tissue oxygen concentration were among the most used.

Doppler ultrasound is a simple, cheap, fast method, but it was not found to have consistent results [5]. Its predictive value was comparable with the clinical assessment in most studies, without supplementary benefits. However, when used in teams with a large experience in intraoperatory ultrasound the rate of anastomotic leaks decreased significantly (2.6 vs. 9.8%) [11].

The use of laser Doppler flowmetry decreased the incidence of anastomotic dehiscence by nearly 60%, significantly limiting the duration of hospitalization and the number of further interventions in elective colorectal surgery [12,13].

Tissue oxygen concentration is also an accurate indicator of viability. A decrease of its concentration by at least 30% of the value recorded prior to the vascular ligation causes necrosis of the anastomosis within 48 hours [14,15].

Although beneficial, the last two methods of assessing intestinal viability are more experimental and not used regularly during surgery due to complex and expensive equipment and trained personnel that are needed to analyze the results [11].

A proper blood flow of the anastomosis is directly related to the anastomotic tension. Together with the mechanical effect over the anastomosis, it is believed that a higher tension can increase the rate of leakage. To our knowledge, further data on this aspect are missing probably due to the difficulty of establishing a suitable experimental model and the possibility of extrapolation of results in clinical practice [16]. However, although its role is hypothetical, a tension-free anastomosis is recommended. In order to achieve it, an adequate mobilization and a proper surgical technique are the most important factors [17].

B. Surgical technique

At the ground of proper anastomotic healing stays a correct and clean surgical technique. Gentle handling of the tissues, a tension free anastomosis and adequate management of the cases can avoid complications. Studies that considered surgeon experience a risk factor for leakage showed inconsistent results, without any statistical differences between seniors and trainees.

Regarding the *suture techniques* by eversing or reversal of anastomotic margins [18], a layer vs. two layers [19], continuous vs. interrupted sutures [20,21], mechanical vs. manual [20,21], classic vs. laparoscopic [22], the results were variable. Clinical and experimental studies did not find any differences between the groups.

However, the authors observed a higher level of stenosis in case of sutures with reversal of edges and double layered, and an increased frequency of fistulas in case of anastomoses performed with continuous thread. In relation to manual sutures, mechanical sutures caused a minimal inflammatory reaction at the level of the anastomosis, with an increased resistance [18,23]. Their effect on collagen concentration is unknown until present.

The option of performing a *protective stoma* is controversial. This has proven its superiority in case of low colorectal anastomoses in male patients, both by decreasing the number of postoperative fistulas and by reducing the number of further surgery and adverse consequences in the event of such complications [24]. Old publications support the negative effects of stomas, explaining that such diversions reduce the amount of collagen and protein synthesis in the distal colon [25,26], but with no present evidence. A protective ileo or colostomy is not an action without complications (ischemia, prolapse, and stenosis) and therefore, the option must be objectively justified.

Mechanical and chemical preparation of the colon is considered a factor on which the opinions are

divided. Classically, the mechanical bowel preparation (MBP) before colorectal intervention was mandatory [25]. Today evidence-based medicine showed that mechanical preparation does not add benefits to colorectal surgery [21,27]. In studies that measured the rate of anastomotic complications between groups with and without MBP, the values weren't statistically significant [28]. Therefore, these results together with the fact that MBP can have major effects on fluid balance and can alter the saprophytic [16,19] indicate that MBP should be removed from daily practice. Potential limitations of the evidence base regarding MBP pre-operatively include lack of standardization.

The association of oral antibiotics lost ground along with the increase of the use of intravenous antibiotics. Some authors insist on combining these two types of administration. The scientific basis of this attitude is derived from the fact that oral antibiotics may reduce the bacterial content of the colon, while intravenous antibiotics provide an efficient concentration in the protection against systemic infections [29].

According to fast-track protocols, the duration of pre-operative fasting should be 2 h for liquids and 6 h for solids and patients should receive single-dose antibiotic prophylaxis against both anaerobes and aerobes about 1 h before surgery [28].

The use of perianastomotic drains is recommended, starting from the idea that the collections that are formed in the vicinity of the anastomosis may cause tension, resulting in anastomotic leakage [30]. In a meta-analysis carried out by Urbach et al. [29] it is concluded that there is insufficient data to demonstrate the efficacy of perianastomotic drainage in reducing the incidence of postoperative fistula. According to the fast-track approach to routine elective surgery, drains have no current role [28].

C. Blood loss

Significant blood loss and the need for transfusion is another important risk factor. The adverse effect of transfusions has been demonstrated on 3 directions: cell-mediated immune response, collagen quality at the level of the anastomosis and septic complications. The cell-mediated immune response implies the effect of transfusions over T lymphocytes and macrophages, both having an essential role in the first steps of digestive healing. It has been shown experimentally also that the administration of red cell units decreases the resistance of anastomoses, by reducing the collagen content and its quality [31].

Contradictory results arise from the cut-off point variability in terms of both blood loss and the number of units transfused, most data coming from retrospective studies [30].

The amount of infusion received intraoperatively is a risk factor that can be easily corrected. In a study published in 2013, Boesen et al. [32] demonstrated that the administration of over 8000 ml of fluids (Ringer's solution, saline solution, fresh frozen plasma or red blood cell units) in an aggregate period of 72 hours preoperatively and intraoperatively significantly increased the risk of anastomotic fistulas. It has been shown by means of a meta-analysis performed on 5 randomized trials that a restricted regimen of intravenous fluids is preferable to a standard regimen because it reduces postoperative complications after colorectal interventions [33]. An increased amount of infusion (hyperhydration of patients) increases the postoperative fistulas rate by decreasing the amount of hydroxyproline and swelling at the perianastomotic level, all these changes decreasing the strength of suture in the first days after surgery [32,34].

D. Duration of surgery

Duration of surgery is a controversial risk factor. Although many authors agree that the duration of surgery is a simple indicator of the difficulty, increased surgery time causes changes in the activity of inflammatory mediators, resulting in a high number of ischemic and septic complications. In this regard, it is recommended to adopt a proper management of the cases according to the patient`s characteristics without unnecessary prolonging the operation time.

Conclusions

Knowledge of these particular risk factors led to new concepts in digestive anastomoses. Avoiding tension and poor vascularization can limit the incidence of digestive leaks, but special measures are required in patients with high risk. The comorbidities and the metabolic imbalances, together with surgery related factors should provide a profile of the patient, being the ground of the right therapeutical method. Further studies should establish methods of reducing and correcting these factors.

Acknowledgements

Project financed of POSDRU grant no. 159/1.5/S/138776, grant with title: Institutional collaborative model for the translation of biomedical research into clinical practice.

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