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The use of Reinforcement Materials in Digestive Surgery

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Anastomotic leak is a severe complication after digestive surgery and is associated with high morbidity and mortality rates. The anastomotic leak incidence in digestive surgery is reported to be between 3% and 19% [1]. Risk factors for anastomotic leak include male sex, obesity, tobacco use, immunosuppression, thrombocytosis, greater operative duration, and urgent/emergency operation, other than surgeons' technical performance. Anastomosis features are crucial as well, including the grade of vascularization of the anastomosis , tension, fibroblast activity, collagen deposition and anastomosis conformation [2].

Anastomotic seal might be potentially improved with a variety of surgical tricks and the implementation of novel devices.

With regard to surgical techniques, traditional reinforcement strategies have proven to be effective in reducing leaks in some series; Reggio et al. [3], for example, demonstrated that a double-layer closure of the enterotomy after ileocolic intracorporeal anastomosis for right colon cancer was associated with a significantly lower incidence of anastomotic leakage, which dropped from 7% to 2%, when compared with one-layer closure.

In the last years, novel strategies and products have become available with the idea of sealing an anastomosis externally with sort of adhesive barriers that can be applied as an extra layer of protection on the serosal surface of the anastomosis. These approaches are gaining more and more popularity with the aid to create a support to reduce the incidence of anastomotic leak. The use of staple line reinforcement is a relatively new possibility in gastrointestinal surgery, although it is well recognized in pulmonary surgery (some studies have shown that its use is able to decrease air leaks after pulmonary resections [4]). Some staple line reinforcement materials have been investigated in scientific studies, including both biologic and non-biologic materials; the use of cyanoacrylate, for example, showed very promising results with an increase of anastomotic strength and reduction of abscess formation. It is a biodegradable tissue that improves the deposition of collagen and , for this reason, it seems to improve the mechanical strength of the anastomosis [1].

The importance of the use of buttressing material has been already evaluated for the bariatric surgery some years ago. Anastomotic stricture is one of the most common complication after laparoscopic gastric bypass, when a gastrojejunostomy is realized with a circularstapler; Scott et al. [5] examined the effect of the use of bioabsorbable circular staple line reinforcement on the incidence of gastrojejunal anastomotic strictures as a complication of laparoscopic roux-en-y gastric bypass. The results of this study showed that the use of polyglycolic acid-trimethylene carbonate staple line reinforcement (Gore Seamguard Bioabsorbable Staple Line Reinforcement, W.L. Gore & Associates, Flagstaff, AZ) decreased the stricture rate in laparoscopic gastric bypass. Seamguard is a synthetic copolymer fiber, with a porous structure that maintains 70% of its tensile strength for 4-6 weeks and is then gradually and fully absorbed within 6 months. The mechanism by which this material would reduce strictures formation could be related to 2 histo-biological aspects: soon after surgery, there is an increase of burst pressure in gastro-jejunal anastomosis with seamguard, without increased inflammation, adhesions or blood vessel recruitment; perhaps this mechanism might potentially avoid anastomotic leak. Moreover, one week after surgery a reduction of collagen deposition in the anastomotic area can be observed. As the bioabsorbable material degrades, sloughing of the staple lines results in lessforeign body remaining at the anastomotic site. This might serve to decrease the long-term inflammatory response and collagen deposition, with the effect to reduce the development of a stricture. Second, this material might provide a type of structural scaffold at the anastomosis, which results in maintaining a more round-shaped opening, avoiding adherence of the staplelines and a resultant stricture.

Another surgical procedure in which the use of Seamguard has been demonstrated is the distal pancreatectomy. Thaker et al. [6] showed that the use of absorbable mesh reinforcement of the stapled pancreatic transection line, is able to reduce the pancreatic leak rate after open and laparoscopic distal pancreatectomy. In their study, the authors proposed 2 mechanisms by which the mesh could promote the reduction of leak rate: the array of mesh fibers may more evenly distribute tension at the resection margin, limiting ischemia or erosion because of pressure; and on the other hand, the material may act as a mechanical barrier to small lacerations and gaps in the staple line, preventing leakage or bleeding.

There is another study that demonstrates the importance in gastrointestinal surgery of Seamguard: Tucker et al. [7] proposed Seamguard as a safe and effective adjunct to endoscopic mesoappendiceal stapling which could prevent intraoperative and postoperative staple line bleeding. Endoscopic stapling is a common approach for the division of the appendix and mesoappendix, but staple line bleeding is commonly observed. Seamguard seemed to provide proficient hemostasis along the mesenteric staple line when used during laparoscopic appendectomy.

The use of linear stapler with bioabsorbable staple line reinforcement material has been proposed for the transanal rectocele repair too, by de la Portilla et al. [8]. One of the most common disadvantage of the staple technique is that bleeding and granuloma formation can occur

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at the staple line. As Seamguard is bioabsorbable, the subsequent absorption of the device, would minimize granuloma formation at the site; the reduction of bleeding rate was probably due to a combination of the device effect and the reinforcing sutures that was adopted during the treatment.

The use of Seamguard seems to be very promising even in the field of colorectal surgery. The leak rate for colorectal anastomosis is usually reported to range between 1 to 10 % [9].

Franklin et al. [9] showed their initial experience about the use of Seamguard for left colon and rectal resection: the results of the study with a short follow-up, showed no anastomotic leakage, bleeding or stenosis. The mechanism proposed is that the addition of bioabsorbable material to the stapled anastomosis may result in a decreased leak rate by neutralizing tension on the staple-line, other than creating a reinforcing plate to prevent the tearing of staples. Hope et al. [10] demonstrated, through a histological analysis, that despite a greater burst pressure in the acute phase (soon after surgery), there was a reduction of leak pressure in the seamguard group, 7 days later. This could be related with a reduction of collagen deposition, demonstrated histologically, which could explain the lower rate of anastomotic stenosis. On the other hand, the higher burst pressure in the acute phase could explain a reduced leak rate; certainly, the state of an anastomosis not only depends on the quantity of collagen deposit, but also on the type and balance of synthesis, lysis, crosslink and site of deposition. Fajardo et al. [11], in fact, hypothesize that the main advantage of Seamguard is not so much related to the fact that it favors the deposition of collagen and elastin necessary for the healing and repair process, but rather because it provides an extracellular matrix (for these substrates) that acts as a scaffold able to consolidate the anastomosis.

Certainly, despite the mechanisms at base of these devices are intriguing and their use in daily practice might possibly mitigate serious complications after gastrointestinal surgery, their real role in clinical practice needs to be fully established within better designed clinical trials.

Competing Interests

The authors declare that they have no competing interests.

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