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Original Article

BURSTING PRESSURE COMPARISON BETWEEN STAPLER AND STAPLE LINE REINFORCEMENT WITH SUTURES AND BUTRESS BIOLOGIC MATERIAL: AN EXPERIMENTAL STUDY

Comparação da pressão de ruptura da linha de sutura com grampeamento simples, com sobressutura e com reforço biológico: estudo experimental

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This study was conducted at Positivo University, Curitiba, Brazil.

ABSTRACT - ***Background***: Staple line leaks carry significant morbidity and mortality. Reinforcement is controversial. Several staple techniques have been described for this purpose. Oversuture and butressing material are more common. ***Aim***: To compare these two ways of reinforcement and staple line without any reinforcement regarding the bursting pressure. ***Method***: Ten segments of small bowel were created in a pig under general anesthesia. The bowel was inflatted until burst point and the pressure was measured. ***Results***: The staple line bursting pressure was 94 mmHg +/- 18,52mmHg in the stapler technique; 87,5 mmHg +/- 18,59mmHg in the oversuture and 83,33 mmHg +/- 23,04mmHg with Surgisis®. There was no statistic difference among the techniques. ***Conclusions***: Oversuture or Surgisis® use did not increase the staple line resistance in pig.

HEADINGS - Surgical stapler. Suture technique. Surgical wound dehiscence.

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DESCRITORES - Grampeadores cirúrgicos. Técnicas de sutura. Deiscência do ferimento operatório.

RESUMO - ***Racional***: A ruptura da linha de grampos representa grave problema em operações gastrointestinais. Reforçar o grampeamento com sobressutura ou dispositivos biológicos é assunto controverso. ***Objetivo***: Comparar a pressão de ruptura do grampeamento simples, com grampeamento com sobressutura e com grampeamento com Surgisis®. ***Método***: Em um suíno anestesiado, foram criados dez segmentos intestinais com cada tipo de grampeamento. Esses segmentos foram insuflados até que rompessem e a pressão de ruptura foi medida para posterior comparação. ***Resultado***: A pressão de ruptura da linha de grampeamento foi de 94 mmHg +/- 18,52mmHg no grupo do grampeamento simples; 87,5 mmHg +/- 18,59 mmHg no grupo de grampeamento com sobressutura; e 83,33mmHg +/- 23,04 mmHg no grupo de grampeamento com Surgisis®. Não houve diferença estatística entre os grupos. ***Conclusões***: O reforço do grampeamento com sobressutura ou aplicação de Surgisis® não aumenta a resistência da linha de grampos em suíno.

INTRODUCTION

For over 200 years surgeons have been using mechanical devices for tissue approximation[18]. In 1908, in Budapest, Hultl produced the first of what would then be called the modern stapler and used it to perform a gastrectomy[16]. The concept of successively recharging the same device was developed by Friedrich in 1934[12]. Surgical staplers started to be more frequently used at the end of World War II, after the development, by the Scientific Institute for Surgical Devices and Instruments in Moscow, of those that would be the forerunners of modern surgical staplers[4]. The Russians also developed the first instruments capable of stapling and cutting[3].

In 1958, when Mark Ravitch was traveling through Russia, he noted the successful use of staplers in lung surgeries. After returning to the United States, he conducted studies that changed the models of the

staplers[22]. In 1963 and 1964, to develop staplers loaded with charges and sterilized for use in rectal anastomosis, Ravitch joined Felix Steichen in a new company, named United States Surgical Corporation (USCC, Norwalk, Connecticut, USA)[22].

With the development of laparoscopic surgery, staplers became more and more useful, since intra-corporeal sutures require more time than in conventional surgery[17]. The increase in number of bariatric surgeries at the end of the 90's, especially those performed by laparoscopy, produced an equivalent increase of the use of surgical staplers.

Failure in stapling and the opening of surgical staples are causes of morbidity and mortality in gastrointestinal procedures, especially in bariatric surgery. The Laparoscopic Roux-en-Y Gastric Bypass is the most frequently bariatric procedure performed in the United States and the incidence of complications related to stapling varies from 0% to 8%[5]. Approximately 37.5% of deaths are related to problems in stapling anastomosis[21].

The reliability in the application of staplers is crucial for a good surgical outcome. Several methods have been proposed to increase its efficiency, like the staple line reinforcement with sutures or the use of buttress biologic material.

The aim of this study was to compare the stapler, the staple line reinforcement with sutures and the stapling with Surgisis® (Cook Medical Incorporated, Bloomington, IN, USA) for resistance of staple line when subjected to pressure.

METHOD

After approval by the Ethics Committee for Experimental Research in Animals of Positivo University, Curitiba, Brazil, a pig was subjected to general anesthesia under the supervision of a veterinarian.

Midline laparotomy was performed to expose all the loops of the small intestine. Then, with a 75mm linear cutter stapler and 3.5mm blue charges, four successive stapling lines were made, with a 10cm distance between them (Edlo®, Canoas, Brazil). The first 11 shots were made exclusively using the stapler to create 10 small bowel portions, each of them 10cm long (Group I). Afterward, 11 new shots were performed, also with 10cm intervals, followed by reinforcing invaginating sutures with 3-0 polypropylene (Ethicon®, Cincinnati, OH, USA), creating 10 new segments of the small intestine (Group II). Finally, the last 11 shots were performed, this time using reinforcement of pig intestine submucosa with Surgisis®, creating 10 more segments of intestine (Group III). Each intestinal segment was progressively inflated with air by a catheter while an air pressure gauge was adapted to a second catheter, with the intent of measuring the rupture pressure of the suture line (Figure 1).

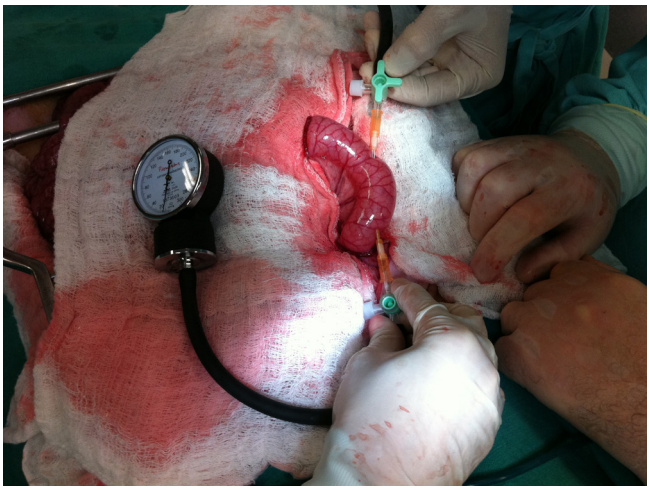

FIGURE 1 - Insufflation of a segment of the small intestine

The values of rupture, in mmHg, were recorded for each group. We then calculated the mean and standard deviation. We also used the Kruskal-Wallis test for comparison between groups.

RESULTS

The group in which was performed the simple stapling (Group I), the burst pressure of the staple line averaged 94mmHg +/- 18.52 mmHg. In the group with the reinforcing invaginating sutures (Group II), burst pressure was 87.5mmHg +/- 18.59mmHg. Finally, the group with reinforcement with Surgisis® showed rupture pressure of 83.33mmHg +/- 23.04mmHg. The data is summarized in Table 1.

TABLE 1 - Bursting pressure of the staple line grampeamento

	Stapler	Staple line reinforcement with suture	Stapling with Surgisis®
Bursting pressure (mmHg)	94 +/- 18,52	87,5 +/- 18,59	83,33 +/- 23,04

Statistical analysis showed no significant difference between groups (p= 0,86).

Despite the fact that these were not the objectives of this study, it was evident that in the group with reinforcement suture the time for preparation of the intestinal segments was significantly higher than in other groups. Also, after subjective evaluation, there was less bleeding in the staple lines in the group which used Surgisis® as reinforcement.

DISCUSSION

Good quality evidence suggests that stapled anastomoses are less susceptible to problems than

the manual ones[7]. However, a good stapler must be able to create good apposition of tissues and hemostasis without causing ischemia and/or tissue damage[4]. Various charges are available for the various types of tissue and certain organs may need more than one type of charge.

It is well established that the cause of rupture of the staple line is multifactorial. The mechanical ruptures are more frequent during the first three days, while ischemic ruptures occur between five and seven post-operative days[4]. Some authors believe that mechanical factors are more frequent than the isquemic[4,19].

The cheapest way to reinforce the staple line is through suture line reinforcement, which, theoretically, improves hemostasis and tissue approximation. Schweitzer and colleagues did not report any leaks through the staple line in 251 successive Laparoscopic Roux-en-Y Gastric Bypasses using a continuous suture as reinforcement[24]. However, several studies are skeptical in regard of the suture line reinforcements, since they are time-consuming, especially in laparoscopic surgeries. Besides, they can cause tissue rupture in the site where the suture thread penetrates that tissue[13,25].

The materials for reinforcement of staple lines were initially used in thoracic surgery[1]. The concept of anchoring the clips in a denser and less frail coating than the tissue that is to be stapled seems interesting. Some studies have shown that the use of such material decreases the bleeding in the staple line[8,11,19,23]. However, it is unclear if it provides benefits in preventing staple line disruption[6].

Assalia et al.[2] showed, in experimental study in pigs, that the use of bovine pericardium does not reduce the occurrence of complications related to the staple line and that the pressure to break the clips was similar with and without reinforcement[20]. Pinheiro and collaborators found diverse results in experimental study in dogs, where the use of an absorbable membrane (Surgisis®) nearly doubled the strength of the staple line when compared to the unreinforced clipping. Other authors found similar results in animal experiments using both bovine pericardium[1,14] and Surgisis®[10] for reinforcement, which was not copied in this study, meaning that this topic remains controversial.

As for clinical aspects, a systematic review by Giannopoulos et al.[15] showed no difference in regard of the staple line rupture in patients undergoing laparoscopic bariatric surgery with and without reinforcement[15]. Dapri et al.[8] randomized patients undergoing vertical gastrectomy in groups with clipping, suture reinforcement and Seamguard® (WL Gore & Associates, Inc, Flagstaff, AZ). They also found no difference between groups in relation to the rupture of the staple line.

The use of nonabsorbable material as stapling reinforcement in bariatric surgery might also result in its migration to the inside of the stomach, generating complications[26] and additional costs[9].

More homogeneous prospective studies are still necessary to complete understanding of the true value of the staple line reinforcements. Tthe technological development of staplers can probably offer, in the near future, even safer clippings.

CONCLUSION

The staple line reinforcement with sutures or the application of Surgisis® do not increase the resistance of the staple line in pigs.

REFERENCES

1. Arnold W, Shikora SA. A comparison of burst pressure between butressed versus non-butressed staple-lines in an animal model. Obes Surg 2005; 15:164-71.
2. Assalia A, Ueda, Matteotti R, Cuenca-Abente F, Rogula T, Gagner M. Staple-line reinforcement with bovine pericardium in laparoscopic sleeve gastrectomy: experimental comparative study in pigs. Obes Surg 2007; 17(2):222-8.
3. Babkin SJ, Astafev GV, Kalinina TV, Androsov PI. Modern equipment for operation on the intestine. In: Elliot JB, Books D, Eds New Soviet Surgical Apparatus and their Application(English translation). New York: Pergamon Press, 1961:137-43.
4. Baker RS, Foote J, Kemmeter P, Brady R, Vroegop T, Serveld M. The science of stapling and leaks. Obes Surg 2004;14:1290-8.
5. Basu NN, Leschinskey D, Heath DI. The use of Seamguard to butress the suture repair of a staple line leak following laparoscopic gastric bypass for obesity. Obes Surg 2008; 18:896-7.
6. Chen B, Kiriakopoulos A, Tsakayannis D, Wachtel MS, Linos D, Frezza EE. Reinforcement does not necessarily reduce the rate of staple line leaks after sleeve gastrectomy. Obes Surg 2009; 19:166-72.
7. Choy PY, Bissett IP, Docherty JG, Parry BR, Merrie AE. Stapled versus handsewn methods for ileocolic anastomoses. Cochrane Database Syst Rev 2007; 18(3):CD004320.
8. Dapri G, Cadière GB, Himpens J. Reinforcing the staple line during laparoscopic sleeve gastrectomy: prospective randomized clinical study comparing three different techniques. Obes Surg 2010; 20(4):462-7.
9. Downey DM, Ali S, Goldblatt MI, Saxe JM, Dolan JP. Gastrointestinal staple line reinforcement. Surg Technol Int 2007; 16:55-60.
10. Downey DM, Harre JG, Dolan JP. Increased burst pressure in gastrointestinal staple-lines during reinforcement with a bioprosthetic material. Obes Surg 2005; 15(10):1379-83.
11. Finks JF, Carlin A, Share D, O'Reilly A, Fan Z, Birkmeyer N. Effect of surgical techniques on clinical outcomes after laparoscopic gastric bypass-results from the Michigan Bariatric Surgery Collaborative. Surg Obes Relat Dis 2010 Oct 16(Epub ahead of print).
12. Friedrich H. Ein eur Magen-Darm-Nahapparat. Zentralbl Chir 1934; 61:304-9.
13. Fullum TM, Aluka KJ, Turner PL. Decreasing anastomotic and staple line leaks after laparoscopic Roux en Y gastric bypass. Surg Endosc 2009; 23(6):1403-8.
14. Gaertner WB, Hagerman GF, Potter MJ, Karulf RE. Experimental evaluation of a bovine pericardium-derived collagen matrix butress in ileocolic and colon anastomoses. J Biomed Mater Res B Appl Biomater 2010; 92(1):48-54.
15. Giannopoulos GA, Tzanakis NE, Rallis GE, Efstathiou SP. Staple line reinforcement in laparoscopic bariatric surgery: does it actually make a difference? A systematic review and meta-analysis. Surg Endosc 2010; 24:2782-8.
16. Hultl H. Zweite Kongress der Gesellschaft fur Chirurgie, Budapest, May 1908. Pester Med-Chir Presse 1909; 45:108-10.

17. Marecik SJ, Chaudhry V, Jan A, Pearl RK, Park JJ, Prasad LM. A comparison of robotic, laparoscopic and hand-sewn intestinal sutured anatomoses performed by residents. AM J Surg 2007; 193:349-55.
18. McGuire J, Wright IC, Leverment JN. Surgical staplers: a review. J R Coll Surg Edinb 1997,42(1):1-9.
19. Miler KA, Pump A. Use of bioabsorbable staple reinforcement material in gastric bypass: a prospective randomized clinical Trial. Surg Obes Relat Dis 2007; 3:417-21.
20. Pinheiro JS, Correa JL, Cohen RV, Novaes JA, Schiavon CA. Staple line reinforcement with new biomaterial increased burst strength pressure: an animal study. Surg Obes Relat Dis 2006; 2(3):397-9.
21. Podnos YD, Jimenez JC, Wilson SE, Stevens CM, Nguyen NT. Complications after laparoscopic gastric bypass: a review of 3464 cases. Arch Surg 2003; 138:957-61.
22. Ravitch MM, Steichen FM, Welter R. Current Practise of Surgical Stapling. Philadelphia, Pennsylvania: Lea and Febeiger, 1991.
23. Saber AA, Scarf KR, Turk AZ, Elgamal MH, Martinez RL. Early experience with intraluminal reinforcement of stapled gastrojejunostomy during laparoscopic Roux-en-Y gastric bypass. Obes Surg 2008; 18:525-9.
24. Schweitzer MA, Lidor A, Magnuson TH. A zero leak rate in 251 consecutive laparoscopic gastric bypass operations using a two-layer gastrojejunostomy technique. J Laparoendosc Adv Surg Tech A 2006; 16:83-7.
25. Shikora SA, Kim JJ, Tarnoff ME. Comparison of permanent and nonpermanent staple line butressing materials for linear gastric staple lines during laparoscopic Roux en Y gastric bypass. Surg Obes Relat Dis 2008; 4:729-34.
26. Yu S, Jastrow K, Clapp B, Kao L, Klein C, Scarborough T, Wilson E. Foreign material erosion after laparoscopic Roux-en-Y gastric bypass: findings and treatment. Surg Endosc 2007; 21(7):1216-20.