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PROCEEDINGS

THE ROLE OF INDOCYANINE GREEN IN COLORECTAL SURGERY

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ABSTRACT

INTRODUCTION: Colorectal cancer is one of the most common gastrointestinal tumors. Anastomotic leakage (AL) after low rectal resections remains a serious problem worldwide, varying between 5% and 20%. The main risk factors for AL are the height of the anastomosis, gender, non-adjuvant therapy, difficult mesorectal excision, advanced age, nutritional status of the patient, as well as the chronic use of certain medications. The concept of intraoperative indocyaninegreen (ICG) angiography is based on its ability to absorb near-infrared (NIR) light up to 800 nm and emit fluorescence at a wavelength of 830 nm. Bolus of ICG is injected into the patient intravenously. After a period of time, NIR light is absorbed by the ICG in the tissues and the resulting fluorescence is a reflection of tissue perfusion.

AIM: The aim of study is to evaluate the efficancy of ICG in colorectal surgery.

MATERIALS AND METHODS: We conducted a retrospective study, with all robotic colorectal resections for the last year, with and without ICG, for perfusion assessement before and after the construction of the anastomosis, as well as the last 48 colorectal cases without the use of ICG.

In our patients, we did not observe significant differences in the operative time (201.6±87.5 min in the ICG and 204.9±76.1 in the group without, 95% CI: −12.42 to 10.87; p=0.87), the intraoperative blood loss (100±78. mL in ICG group and 98±68 mL in the other; 95% CI: −16.43 to 7.35; p=0.42), and in the need for blood transfusion in both groups (95% CI: 0.37–2.72; p=1.10). The incidence of AL in the ICG and non-ICG group was 1/16.6.2% vs. 4/48,8.3%, (95% CI: 0.39–0.56; p<0.). In the hospital stay, we did not observe a significant difference in the two groups. It was 6.7±5.2 days in the group with ICG and 6.5±5.1 in the group without (95% CI: −0.84 to 0.05; p=0.08).

CONCLUSION: The results of our study support the thesis of most authors about reducing the AL rate when using ICG. Larger multicenter studies are needed to confirm these data.

Keywords: *indocyanine green, colorectal surgery, anastomotic leakage*

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INTRODUCTION

Colorectal cancer is one of the most common gastrointestinal tumors. Anastomotic leakage (AL) after low rectal resection remains a serious problem worldwide, varying between 5% and 20% (1). The main risk factors for AL are the height of the anastomosis, gender, non-adjuvant therapy, difficult mesorectal excision, advanced age, nutritional status of the patient, as well as the chronic use of certain medi-

cations. Broadly, these factors can be divided into patient-related immutable and modifiable that can be influenced due to advances in science and technology (2). One of these potentially modifiable factors is intestinal perfusion status, which surgeons can assess (3). High ligation of the inferior mesenteric artery has been accepted as a mandatory step in resection of left colon and rectum. According to numerous studies, this may lead to hypoperfusion of the affected large intestine. Nearly 50% of the leakages could be related to hypoperfusion of the anastomosing intestinal segments. To determine the blood flow, mainly macroscopic methods are used, including the visual assessment of the type and color, as well as the presence of peristalsis. This method is imprecise and depends on the experience of the surgeon and the time that has passed after vessel ligation (4).

The concept of intraoperative indocyanine (ICG) angiography is based on its ability to absorb near-infrared (NIR) light up to 800 nm and emit fluorescence at a wavelength of 830 nm. Albumin is the most important intravascular binding protein for ICG, so tissue microperfusion is revealed by the presence of fluorescence. Briefly, a bolus of ICG is injected into the patient intravenously. After a period of time, NIR light is absorbed by the ICG in the tissues and the resulting fluorescence is a reflection of tissue perfusion (5,6). Currently, ICG angiography is rapidly gaining popularity in colorectal surgery. Its clinical benefit in reducing anastomotic complications is the subject of multicenter randomized clinical trials. Expectations and interests in ICG angiography among surgeons are constantly increasing (4,7).

AIM

The aim of this study is to evaluate the efficacy of ICG in colorectal surgery.

MATERIALS AND METHODS

We conducted a retrospective study including all robotic colorectal resections for the last year, with and without ICG, for perfusion assessement before and after the construction of the anastomosis.

The inclusion criteria were: (1) patients with proven colorectal carcinoma; (2) patients with colorectal carcinoma and ICG use.

The exclusion criteria were: (1) presence of widespread metastatic disease; (2) existing simultaneous liver resections; (3) patients with emergency surgery ileus and Hartmann's procedure.

RESULTS

In our patients, we did not observe significant differences in the operative time (201.6±87.5 min in the ICG group, and 204.9±76.1 in the group without ICG, 95% CI: –12.42 to 10.87; p=0.87), intraoperative blood loss (100±78 mL in the ICG group and 98±68 mL in the one without ICG; 95% CI: –16.43 to 7.35; p=0.42), and the need for blood transfusion in both groups (95% CI: 0.37–2.72; p=1.10). These results are logical given the fact that we use ICG only to check the perfusion of the anastomosing intestinal segments.

The incidence of AL in the ICG and non-ICG group was 1/16, 6.2% vs. 4/48, 8.3%, (95% CI: 0.39–0.56; p<0.), but comparing the frequency of dehiscence in low anastomoses, the difference is significant and in favor of the group with ICG with 1/8, 12.5% and 1/14, 7.14%.

When comparing the hospital stay, we did not observe a significant difference in the two groups, it was 6.7±5.2 days in the group with ICG and 6.5±5.1 in the one without ICG (95% CI: –0.84 to 0.05; p=0.08).

DISCUSSION

Anastomotic leakage in colorectal surgery remains one of the most severe and frightening complications. Despite advances in technology, improvement in surgical instrumentation and techniques, this incidence still remains high at 10–24%, and more alarming is the fact that, according to a number of studies, one in three patients will die from septic complications as a result of AL (8,9).

Several risk factors have been blamed for AL: obesity, neo-adjuvant radiation and/or chemotherapy, male gender, hypoproteinemia, hypoalbuminemia, use of certain medications, smoking, anastomotic height is one of the main factors. Technical aspects crucial to proper anastomotic healing are tension and adequate blood supply to the anastomosis (10).

Traditionally, such assessment is highly subjective and is based on visible active bleeding from the cut tissue and the absence of bowel color change observed by the surgeon. A number of studies, aimed to evaluate the effectiveness of ICG, have found that in

approximately 6–9% of the cases of macroscopically confirmed viability of the anastomosing intestinal segments, a lack of sufficient perfusion is observed (11,12). Such finding requires re-resection of the non-sufficiently blood-supplied areas. More interesting is the fact that the use of immunofluorescence assessment of the degree of perfusion in case of re-resection of an intestinal segment does not significantly increase the operative time, but significantly reduces the percentage of leakage from the side of the anastomosis (12).

A meta-analysis covering 554 cases of colorectal resections conducted by Blanco-Colino et al. showed a significantly lower incidence of anastomotic complications in patients using ICG (9), (1.1% vs. 6.1%,). Our study supports the authors' thesis (12,13).

The frequency of early postoperative complications with the use of ICG was found to be significantly lower. This result could be explained by the fact that they are mainly due to hemorrhage, early postoperative ileus, or anastomotic complications. Reducing the frequency of one of them leads to a decrease in the complication rate, and this will reflect on the hospital stay. It is logical that with a reduction of AL in the ICG group, the hospital stay would be reduced. We did not observe such significant difference in our patients (14,15).

It is interesting that, according to most authors, as well as our results, there is no increase in the operative time with the use of ICG. This is due to the easy execution of the procedure carried out by a members of the anesthesia team (16).

CONCLUSION

The results of our study support the thesis of most authors about reducing the AL rate when using ICG. Larger multicenter studies are needed to confirm these data. However, the ease of performing the procedure, its safety, as well as the good results cited in a number of studies make it an attractive new method that can solve some of the problems related to AL in colorectal surgery.

REFERENCES

1. Yeung TM. Fluorescence imaging in colorectal surgery. Surg Endosc. 2021;35(9):4956-63. doi: 10.1007/s00464-021-08534-7.
2. Park JS, Choi GS, Kim SH, et al. Multicenter analysis of risk factors for anastomotic leakage after laparoscopic rectal cancer excision: the Korean laparoscopic colorectal surgery study group. Ann Surg. 2013;257(4):665-71. doi: 10.1097/SLA.0b013e31827b8ed9.
3. Son GM, Kwon MS, Kim Y, Kim J, Kim SH, Lee JW. Quantitative analysis of colon perfusion pattern using indocyanine green (ICG) angiography in laparoscopic colorectal surgery. Surg Endosc. 2019;33(5):1640-9. doi: 10.1007/s00464-018-6439-y.
4. Park SY, Park JS, Kim HJ, Woo IT, Park IK, Choi GS. Indocyanine green fluorescence imaging-guided laparoscopic surgery could achieve radical D3 dissection in patients with advanced right-sided colon cancer. Dis Colon Rectum. 2020;63(4):441-9. doi: 10.1097/DCR.0000000000001597.
5. Destro M, Puliafito CA. Indocyanine green videoangiography of choroidal neovascularization. Ophthalmology. 1989;96(6):846-53. doi: 10.1016/s0161-6420(89)32826-0.
6. De Nardi P, Elmore U, Maggi G, Maggiore R, Boni L, Cassinotti E, et al. Intraoperative angiography with indocyanine green to assess anastomosis perfusion in patients undergoing laparoscopic colorectal resection: results of a multicenter randomized controlled trial. Surg Endosc. 2020;34:53-60.
7. Ismael G, Al Furajji H, Cahill RA. Near-infrared laparoscopic fluorescence to guide fascial plane identification in total mesorectal excision for rectal cancer: A Video Vignette. Colorectal Dis 2015;17 Suppl 3:36. doi: 10.1111/codi.13089.
8. McDermott FD, Heeney A, Kelly ME, Steele RJ, Carlson GL, Winter DC. Systematic review of preoperative, intraoperative and postoperative risk factors for colorectal anastomotic leaks. Br J Surg. 2015;102(5):462-79. doi: 10.1002/bjs.9697.
9. Choi HK, Law WL, Ho JW. Leakage after resection and intraperitoneal anastomosis for colorectal malignancy: analysis of risk factors. Dis Colon Rectum. 2006;49(11):1719-25. doi: 10.1007/s10350-006-0703-2.
10. Spinelli A, Carvello M, Kotze PG, Maroli A, Montroni I, Montorsi M, et al. Ileal pouch-anal anastomosis with fluorescence angiography: a case-matched study. Colorectal Dis. 2019;21(7):827-32. doi: 10.1111/codi.14611.
11. Jafari MD, Wexner SD, Martz JE, McLemore EC, Margolin DA, Sherwinter DA, et al. Perfusion as-

sessment in laparoscopic left-sided/anterior resection (PILLAR II): a multi-institutional study. J Am Coll Surg. 2015;220(1):82-92.e1. doi: 10.1016/j.jamcollsurg.2014.09.015.

12. Safiejko K, Tarkowski R, Kozlowski TP, Koselak M, Jachimiuk M, Tarasik A, et al. Safety and efficacy of indocyanine green in colorectal cancer surgery: a systematic review and meta-analysis of 11,047 patients. Cancers (Basel). 2022;14(4):1036. doi: 10.3390/cancers14041036.

13. Blanco-Colino R, Espin-Basany E. Intraoperative use of ICG fluorescence imaging to reduce the risk of anastomotic leakage in colorectal surgery: a systematic review and meta-analysis. Tech Coloproctol. 2018;22(1):15-23. doi: 10.1007/s10151-017-1731-8.

14. Kudszus S, Roesel C, Schachtrupp A, Höer JJ. Intraoperative laser fluorescence angiography in colorectal surgery: a noninvasive analysis to reduce the rate of anastomotic leakage. Langenbecks Arch Surg. 2010;395(8):1025-30. doi: 10.1007/s00423-010-0699-x.

15. Ishii M, Hamabe A, Okita K, Nishidate T, Okuya K, Usui A, et al. Efficacy of indocyanine green fluorescence angiography in preventing anastomotic leakage after laparoscopic colorectal cancer surgery. Int J Colorectal Dis. 2020;35(2):269-75. doi: 10.1007/s00384-019-03482-0.

16. Alekseev M, Rybakov E, Shelygin Y, Chernyshov S, Zarodnyuk I. A study investigating the perfusion of colorectal anastomoses using fluorescence angiography: results of the FLAG randomized trial. Colorectal Dis. 2020;22(9):1147-53. doi: 10.1111/codi.15037.