

Title:

Endoscopic tattooing of colorectal neoplasms removed by laparoscopy: a proposal for selective marking

Authors:

Sandra Alonso, Silvia Pérez, Núria Argudo, José Isaac Latorraca, Marta Pascual, Marco Antonio Álvarez, Agustín Seoane, Luis Eugenio Barranco, Luis Grande, Miguel Pera

DOI: 10.17235/reed.2017.5136/2017

Link: [PubMed \(Epub ahead of print\)](#)

Please cite this article as:

Alonso Sandra, Pérez Silvia, Argudo Núria, Latorraca José Isaac, Pascual Marta, Álvarez Marco Antonio, Seoane Agustín, Barranco Luis Eugenio, Grande Luis, Pera Miguel. Endoscopic tattooing of colorectal neoplasms removed by laparoscopy: a proposal for selective marking. Rev Esp Enferm Dig 2017. doi: 10.17235/reed.2017.5136/2017.



This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

OR 5136 inglés

Endoscopic tattooing of colorectal neoplasms removed by laparoscopy: a proposal for selective marking

Sandra Alonso^{1,2}, Silvia Pérez¹, Núria Argudo¹, José Isaac Latorraca¹, Marta Pascual^{1,2}, Marco Antonio Álvarez³, Agustín Seoane³, Lluís Barranco³, Luis Grande^{1,2} and Miguel Pera^{1,2}

¹Section of Colon and Rectal Surgery. Department of Surgery. Hospital del Mar. Barcelona. ²Colorectal Neoplasms Clinical and Translational Research Group. Hospital de Mar Medical Research Institute (IMIM). Barcelona. ³Gastrointestinal Endoscopy Unit. Hospital del Mar. Barcelona

Received: 26/06/2017

Accepted: 09/08/2017

Correspondence: Sandra Alonso Gonçalves. Section of Colon and Rectal Surgery. Department of Surgery. Hospital del Mar. Passeig Marítim, 25-29. 08003 Bcelona
e-mail: Salonso@parcdesalutmar.cat

ABSTRACT

Background and aim: Preoperative endoscopic tattooing is an effective procedure to identify small intraoperative neoplasms. However, there are no defined criteria with regard to the indications for endoscopic tattooing of these lesions at the time of diagnosis. The aim of this study was to establish endoscopic criteria that allow the selection of patients who will need a tattoo during the diagnostic colonoscopy.

Methods: An ambispective study of patients undergoing laparoscopy due to a colorectal neoplasia who underwent endoscopic tattooing during the period from 2007-2013 and 2016-2017. According to the endoscopic description of the neoplasms,

the classification was polypoid lesions, neoplasms occupying < 50% or \geq 50% of the intestinal lumen and stenosing neoplasias.

Results: Tattooing of the lesion was performed in 120 patients and the same lesions were identified during surgery in 114 (95%) cases. Most of the neoplasias described as polypoids and neoplasias that occupied < 50% of the intestinal lumen were not visualized during surgery and therefore required a tattoo (33 of 42 and 18 of 26 respectively, $p = 0.0001$, χ^2). On the other hand, stenosing lesions or neoplasias occupying \geq 50% of the intestinal lumen were mostly identified during surgery (15 of 15 and 36 of 37 respectively, $p = 0.0001$, χ^2) without the need for a tattoo. Overall, the identification of neoplasms according to established criteria was 98%.

Conclusion: These results suggest that it is possible to establish endoscopic criteria that allow a successful selective tattooing during diagnostic endoscopy.

Key words: Tattoo. Indian ink. Colorectal neoplasms. Laparoscopy.

INTRODUCTION

Several randomized controlled trials and meta-analysis have shown that laparoscopic colorectal surgery is associated with a better postoperative pain control, faster recovery of the intestinal transit and a shorter hospital stay compared to open surgery (1-3). However, one of the limitations of minimally invasive surgery is decreased tactile sensitivity, which makes it difficult to identify small neoplasms (4,5). In such cases, several techniques have been proposed to facilitate intraoperative identification of these lesions. Currently, the most commonly used technique is preoperative endoscopic tattooing (6). This is an effective and safe procedure with a precision for the localization of the lesion between 70-100% (7).

Current recommendations for tattooing colonic neoplasms are not very specific. In 2013 the SAGES (Society of American Gastrointestinal and Endoscopic Surgeons) evidence-based guidelines for the laparoscopic resection of curable colon and rectal cancer recommended marking all small lesions without clearly specifying their size (8). On the other hand, a recent systematic review by Acuna et al. (9) suggested tattooing

all lesions located in the transverse and left colon. In some cases the indication for marking the neoplasm is made by the endoscopist during the diagnostic colonoscopy, depending on the size and location of the lesion. In other cases the indication is made later by the surgeon, therefore the endoscopy must be repeated (10). Moreover, in a high percentage of patients in whom the preoperative tattooing has been performed, it is possible to identify the neoplasia during the laparoscopic examination without marking. Unnecessary marking incurs a higher cost (11), discomfort for the patient, a longer procedure time and in some cases, may hamper the subsequent surgical procedure.

On the basis of these observations, the objective of this study was to establish endoscopic criteria for the selection of patients that require a tattoo during the diagnostic colonoscopy, avoiding a repeat preoperative endoscopy and unnecessary markings.

METHODS

Study design and participants

This was an ambispective cohort descriptive study that included all patients who underwent laparoscopic colectomy for a colonic neoplasm with an endoscopic tattoo. The period between January 2007 and June 2013 was analyzed retrospectively and the period between July 2016 and February 2017 was analyzed prospectively. Polyps treated by polypectomy for which the resection base was marked due to a suspicion of a malignant neoplasm were excluded. All endoscopies and tattooing were performed by experienced gastroenterologists and all operations were performed by surgeons from the Section of Colon and Rectal Surgery at Hospital del Mar.

Tattooing technique

The submucosal injection with Spot (GI Supply, Camp Hill, PA, United States) technique was used in all patients. First, 0.9% saline was injected in the submucosa distal to the lesion in at least two quadrants in order to form a submucosal bleb. Subsequently, a suspension of highly purified carbon particles was injected into the submucosal bleb (6). This technique achieves an accurate intraoperative identification of the tattoo with

a low associated morbidity (12,13).

Endoscopic classification

At the time of the study there was no protocol established for the marking of these lesions in our institution. After discussion with the endoscopist, it was decided that neoplasms located in the cecum and neoplasms of the rectum and rectosigmoid junction should not be tattooed. In these cases, the anatomical references allow easy localization of the tumor. In addition, when the rectum is tattooed, the ink diffuses through the mesorectum and hinders the surgical technique. With the exception of these two locations, the tattooing of the lesion was performed according to the criteria of the endoscopist that performed the diagnostic colonoscopy. In some cases, tattooing was requested by the surgeon that performed the operation.

In order to establish simple endoscopic criteria, neoplasms were classified into four groups according to the detailed description in the colonoscopy report: lesions with a polypoid appearance with a predominantly intraluminal growth, infiltrating neoplasms occupying less than 50% of the intestinal lumen, neoplasms occupying 50% or more of the intestinal lumen and stenosing neoplasms.

During the surgery the tattoo was classified as visible or non-visible and whether the endoscopic location of the tumor corresponded to the affected colonic segment was also determined.

Ethical considerations

National and international guidelines (deontological code, Helsinki Declaration) and legal regulations with regard to data confidentiality (Organic Law 15/1999 of 13 December on the Protection of Personal Data [LOPD]) were followed.

Statistical analysis

Demographic variables, the endoscopic characteristics of the neoplasia according to the previously described criteria and the location of the lesion were recorded for the entire patient cohort. Variables related to the tattooing technique including complications, the need for a second endoscopy for marking, time between

performing the tattoo and surgery, visualization of the tattoo and identification of the neoplasia during the surgical intervention were also recorded.

Continuous variables were expressed as mean +/- standard deviation or median and IQR (interquartile range). Categorical data were expressed as absolute numbers and percentages. The Chi-square test was used for categorical variables. A value of $p < 0.05$ was used to determine the level of statistical significance. Statistical analyses were performed with SPSS version 18.0 (SPSS Inc, Chicago, IL).

RESULTS

One hundred and twenty patients with colonic neoplasms tattooed and operated by laparoscopy were included in the study (80 patients retrospectively and 40 prospectively). The mean age was 68 ± 12 years. The most frequent endoscopic localization of the neoplasia was the sigmoid colon followed by the ascending colon, in 59 (49%) and 29 (24%) patients, respectively. Other neoplasms were located in the transverse colon in 15 patients, the upper rectum in 10 and in the descending colon in 7 patients.

Table 1 shows the classification of neoplasms according to the endoscopic criteria described previously. More than half of the neoplasms were described as polypoids and/or occupied less than half of the circumference. The neoplasms were tattooed during the diagnostic endoscopy in 92 (77%) patients, whereas a second colonoscopy was needed to mark the lesion in the remaining 28 (23%) cases. There were no complications related to the tattooing technique. However, there were two complications related to the colonoscopy, one perforation and one post-polypectomy hemorrhage (1.6%). The median time between tattooing and surgery was 40 (22-59) days.

Table 2 shows the intraoperative characteristics of the tattoo and the surgical procedures performed. The tattoo was not visualized in 6 patients (5%). The tumor was subsequently identified during laparoscopy in 5 cases and an intra-operative colonoscopy was necessary in the final case. The location of the neoplasia was the ascending-transverse colon in 4 cases and the rectosigmoid junction and upper rectum in 2 cases. Ninety-seven (81%) of the lesions were identified as adenocarcinomas and

23 (19%) were identified as adenomas by anatomopathological analysis.

There was a discrepancy between the location described by the endoscopist and that observed by the surgeon during the laparoscopy in 10 cases. Three of the neoplasms endoscopically located in the sigmoid colon were found to be in the rectum and 2 in the descending colon. Of the 3 neoplasms endoscopically located in the descending colon, 2 were found in the sigma and one in the transverse colon. Two neoplasms described by the endoscopist in the ascending and transverse colon were found by the surgeon in the transverse colon and ascending colon, respectively. Table 3 shows the endoscopic characteristics of the neoplasms according to the established criteria and whether they were identified during laparoscopy independently of the tattoo. In these cases, marking is unnecessary.

The location of the neoplasms during surgery, whether by endoscopic tattooing or by direct visualization by the surgeon, was possible in 119 (99%) cases. Fifteen stenosing neoplasms and 36 of 37 neoplasms that occupied more than half of the circumference could have been identified by the surgeon without the tattoo (98%). Whereas only 9 of 42 polypoid neoplasms and 8 out of 26 neoplasms occupying less than 50% of the circumference were identified intra-operatively without marking (25%). This difference was statistically significant ($p = 0.0001$). Based on the proposed endoscopic criteria, an identification rate of 98% by laparoscopy could be achieved when only tattooing those neoplasms described endoscopically as polypoids and those occupying less than 50% of the circumference.

DISCUSSION

The results of this study suggest that it is possible to establish selective criteria for tattooing colonic neoplasms that reduce the number of unnecessary tattoos, while maintaining an identification percentage of almost 100%. The choice of simple endoscopic criteria facilitates the decision to perform a tattoo during the diagnostic colonoscopy, therefore decreasing the number of patients that require a second colonoscopy for marking the neoplasms. In this study, the frequency was 23%.

The identification of colonic neoplasms during surgery is particularly important when using a laparoscopic approach, as the marking error rate during diagnostic colonoscopy

reaches 15% (9-14). In this study, the percentage of inaccurate location marking was only 8%. This may be due to the fact that all procedures in the present study were performed by endoscopists with a wide experience and who have performed over 1000 annual endoscopies. Colonoscopy is highly operator-dependent which explains the great variability reported in the frequency of inaccurate marked locations.

Different methods have been reported to facilitate the localization of colonic neoplasms during laparoscopic surgery. A barium enema identifies lesions of a large and medium size but small neoplasms are often difficult to identify. On the other hand, computed tomographic colonography can identify lesions greater than 1 cm with an adequate anatomical accuracy but with a considerable radiation index (15,16).

Endoscopic indocyanine green marking is a safe and effective method but has some limitations. Specific devices are required in the operating room to visualize this soluble dye and in some cases the marking is not visible during surgery 8 days after marking (17). Therefore, the technique of choice for the localization of colonic neoplasms treated by a laparoscopic approach is Spot® tattooing (13-18). In our series, the tattoo was visualized in the majority of patients and the mark made with Indian ink was not identified in only 6 (5%) cases. The endoscopic technique was the same and there was no difference with regard to the time between the tattooing procedure and surgery, therefore it is unlikely due to technical failure. The rates reach 30% in other series (5).

There are currently no specific recommendations with regard to the colonic tumors that should be tattooed by endoscopy. Quality guidelines in the detection and diagnosis of colorectal cancer endorsed by the European Commission recommend that all suspicious lesions regardless of size should be tattooed (19). Zafar et al. (20) recommend that polyps greater or equal to 10 mm for endoscopic resection, regardless of the endoscopic appearance, should be tattooed due to the greater risk of malignancy. However, if all resected polyps are marked according to these criteria, this could create problems in a future colectomy. There may be several tattoos that could create confusion for the surgeon with regard to selecting the segment for surgical resection. The tattoo with Indian ink is permanent and therefore can be identified several years later (5).

In the absence of a consensus for the indications of tattooing colonic neoplasms, it is important to establish precise and simple marking criteria that can be applied during the diagnostic colonoscopy. A second endoscopy for marking is not a trivial matter in these patients; the rate was 23% in this series. In a study of almost 350 patients (10), a second colonoscopy was necessary in 40% of cases. A re-endoscopy is associated with a greater discomfort for the patient, a repeat mechanical bowel preparation and other associated risks such as colonic perforation (0.08% to 0.16%) (21,22). Moreover, this is associated with an unnecessary use of healthcare resources.

Morphological criteria to select neoplasms for a preoperative tattoo were analyzed in this study. The aim was to establish simple and easy to apply criteria based on the circumferential involvement of the intestinal wall and the appearance of the lesion. Post-polypectomy scars were excluded as tattooing is mandatory in these cases, even in open surgery. On the other hand, tattooing is not necessary for neoplasms located in the cecum and rectum as neoplasms in these locations can be easily localized. In the present series, 10 upper rectum neoplasms were included as they were found in the distal sigmoid colon at the time of the diagnostic endoscopy. We have retained these neoplasms in the analysis as the morphological description of these neoplasms could contribute to the establishment of selective endoscopic tattooing criteria.

On the other hand, the neoplasms were marked in all patients and the assessment of the surgeon may be biased. However, all surgeons that participated in the present study were specialists in colon and rectal surgery and appreciate the importance of a strict evaluation. The intra-operative location of colonic neoplasms may be more problematic and the surgery time prolonged and in some cases converted to open surgery if these criteria are not applied.

The results of the present study confirm that tattooing stenosing lesions is unnecessary as they are always clearly identified intra-operatively due to their large size. In addition, the majority of neoplasms occupying more than half of the circumference can be identified without marking. Therefore, only neoplasms with a polypoid morphology and those limited to less than half of the intestinal circumference should be tattooed, as these tumors cannot be identified by laparoscopic approach.

In conclusion, our results suggest that it is possible to establish simple and precise endoscopic criteria that allow a selective tattooing of lesions during a diagnostic endoscopy in patients with colonic neoplasms. These results should be prospectively validated in a larger cohort of patients.

Accepted Article

REFERENCES

- 1 Bonjer HJ, Hop WC, Nelson H, et al. Laparoscopically assisted vs open colectomy for colon cancer: a meta-analysis. *Arch Surg* 2007;142(3):298-303. DOI: 10.1001/archsurg.142.3.298
- 2 Gillou PJ, Quirke P, Thorpe H, et al. Short-term endpoints of conventional versus laparoscopic-assisted surgery in patients with colorectal cancer (MRC CLASSIC trial): multicenter, randomized controlled trial. *Lancet* 2005;365(9472):1718-26. DOI: 10.1016/S0140-6736(05)66545-2
- 3 Veldkamp R, Kuhry E, Hop WC, et al. Laparoscopic surgery versus open surgery for colon cancer: short-term outcomes of randomised trial. *Lancet Oncol* 2005;6(7):477-84. DOI: 10.1016/S1470-2045(05)70221-7
- 4 Holzman MD, Eubanks S. Laparoscopic colectomy. Prospects and problems. *Gastrointest Endosc Clin N Am* 1997;7(3):525-39.
- 5 Elarini T, Wexner SD, Iseberg GA. The need for Standardization of colonoscopic tattooing of colonic lesions. *Dis Colon Rectum* 2015;58(2):264-7. DOI: 10.1097/DCR.0000000000000304
- 6 Ponsky JL, King JF. Endoscopic marking of colonic lesions. *Gastrointest Endosc* 1975;22(1):42-3. DOI: 10.1016/S0016-5107(75)73687-8
- 7 Askin MP, Waye JD, Friedler L, et al. Tattoo of colonic neoplasms in 113 patients with a new sterile carbon compound. *Gastrointest Endosc* 2002;56(3):339-42. DOI: 10.1016/S0016-5107(02)70035-7
- 8 Zerey M, Hawver LM, Awad Z, et al. SAGES evidence-based guidelines for the laparoscopic resection of curable colon and rectal cancer. *Surg Endosc* 2013;27:1-10. DOI: 10.1007/s00464-012-2592-x
- 9 Acuna SA, Elmi M, Shah PS, et al. Preoperative localization of colorectal cancer: a systematic review and meta-analysis. *Surg Endosc* 2017;31(6):2366-79. DOI: 10.1007/s00464-016-5236-8
- 10 Al Abbasi T, Saleh F, Jackson TD, et al. Preoperative re-endoscopy in colorectal cancer patients: an institutional experience and analysis of influencing factors. *Surg Endosc* 2014;28(10):2808-14. DOI: 10.1007/s00464-014-3549-z

- 11 Sharara N, Adam V, Crott R, et al. The costs of colonoscopy in a Canadian hospital using a microcosting approach. *Can J Gastroenterol* 2008;22(6):565-70. DOI: 10.1155/2008/854984
- 12 Moss A, Bourke MJ, Pathmanathan N. Safety of colonic tattoo with sterile carbon particle suspension: a proposed guideline with illustrative cases. *Gastrointest Endosc* 2011;74(1):214-8. DOI: 10.1016/j.gie.2011.01.056
- 13 Ferlitsch M, Moss A, Hassan C, et al. Colorectal polypectomy and endoscopic mucosal resection (EMR): European Society of gastrointestinal Endoscopy /ESGE Clinical Guideline. *Endoscopy* 2017;49(3):270-97. DOI: 10.1055/s-0043-102569
- 14 Vignati P, Welch JP, Cohen JL. Endoscopic localization of colon cancers. *Surg Endosc* 1994;8(9):1085-7. DOI: 10.1007/BF00705725
- 15 Rockey DC, Paulson E, Niedzwiecki D, et al. Analysis of air contrast barium enema, computed tomographic colonography, and colonoscopy: prospective comparison. *Lancet* 2005;365(9456):305-11. DOI: 10.1016/S0140-6736(05)70194-X
- 16 Brenner DJ, Hall EJ. Computed tomography-an increasing source of radiation exposure. *N Engl J Med* 2007;357(22):2277-84. DOI: 10.1056/NEJMra072149
- 17 Miyoshi N, Ohue M, Noura S, et al. Surgical usefulness of indocyanine green as an alternative to India ink for endoscopic marking. *Surg Endosc* 2009;23(2):347-51.
- 18 Feingold DL, Addona T, Forde KA, et al. Safety and reliability of tattooing colorectal neoplasms prior to laparoscopic resection. *J Gastrointest Surg* 2004;8(5):543-6.
- 19 European Commission (2011) European guidelines for quality assurance in colorectal cancer screening and diagnosis. Available at: <http://www.europacoln.com>. Accessed 11 Aug 2011
- 20 Zafar A, Mustafa M, Chapman M. Colorectal polyps: when should we tattoo? *Surg Endosc* 2012;26(11):3264-6. DOI: 10.1007/s00464-012-2335-z
- 21 Araghizadeh FY, Timmcke AE, Opelka FG, et al. Colonoscopic perforation. *Dis Colon Rectum* 2001;44(5):713-6. DOI: 10.1007/BF02234572
- 22 Alonso S, Dorcaratto D, Pera M, et al. Incidence of iatrogenic perforation during colonoscopy and their treatment in a university hospital. *Cir Esp* 2010;88(1):41-5. DOI: 10.1016/j.ciresp.2010.04.004

Table 1. Classification of neoplasms

<i>Endoscopic description</i>	<i>n = 120 (%)</i>
Polypoid lesions	42 (35)
Neoplasm < 50% circumference	26 (22)
Neoplasm > 50% circumference	37 (31)
Stenosing neoplasm	15 (12)

Table 2. Characteristics of intraoperative marking and surgical procedures

<i>Intraoperative identification of the tattoo</i>	<i>n = 120 (%)</i>
Visible	114 (95)
Not visible	6 (5)
<i>Endoscopic localization:</i>	
Correct	110 (92)
Incorrect:	10 (8)
- Sigmoid	5
- Descending colon	3
- Ascending-transverse colon	2
Presence of ink in other locations	27 (22)
<i>Surgical intervention:</i>	
Sigmoidectomy	56 (47)
Right hemicolectomy	28 (23)
Anterior rectal resection	14 (12)
Enlarged right hemicolectomy	15 (12)
Left hemicolectomy	7 (6)

Table 3. Endoscopic characteristics and identification of the neoplasm during the laparoscopy procedure

<i>Endoscopic description</i>	<i>Not identified in surgery</i>	<i>Identified during laparoscopy</i>	<i>p</i>
Polypoid lesions	33	9	0,0001
Neoplasm < 50% circumference	18	8	
Neoplasm > 50% circumference	1	36	
Stenosing neoplasm	0	15	
Total	52	68	

Chi-square test (X²).