

Inconsistencies in Colonic Tattooing Practice: Differences in Reported and Actual Practices at a Tertiary Medical Center

Joshua P. Spaete, MD, Jiayin Zheng, PhD, Shein-Chung Chow, PhD,
Rebecca A. Burbridge, MD, and Katherine S. Garman, MD

Objectives: Accurate localization of a colonic lesion is crucial to successful resection. Although colonic tattooing is a widely accepted technique to mark lesions for future identification surgery or repeat colonoscopy, no consensus guidelines exist. The objective of this study was to determine whether the current tattooing practice at a tertiary medical center differs from recommendations in the literature and self-reported provider practice.

Methods: The study consisted of an observational retrospective chart review of patients who received colonic tattoos, as well as a provider survey of reported tattooing practices at a tertiary academic medical center. A total of 747 patients older than 18 years of age who underwent colonoscopy with tattoo were included. Forty-four gastroenterologists performing endoscopy were surveyed on tattooing techniques.

Results: In the majority of cases, neither the number of tattoos, location of the tattoo nor the distance from the lesion was specified within the report. Following the index procedure, a tattoo was detected in 75% of surgical resections and 73% of endoscopies. At the time of surgery, however, the tattoo and/or the lesion was detected approximately 94% of the time. Twenty-five endoscopists (56.8%) completed the survey. Differences were seen between the chart review and reported practice. Most providers report placing ≥ 2 marks (87.2%); however, chart review revealed that only 56.2% were tattooed with ≥ 2 marks.

Conclusions: Variation exists between the reported tattooing practice and actual practice. Despite this, most tattoos are identified at the time of surgery or repeat endoscopy. Further research is needed to determine whether a standardized approach to tattooing and reporting could improve localization at repeat endoscopy.

Key Words: colon cancer, colonoscopy, colon polyp, colon tattoo

Colorectal cancer is the second leading cause of cancer-related death in the United States, with an estimated 49,000 deaths in 2016.¹ Colonoscopy is associated with a reduced incidence of colorectal cancer and reduced colorectal-cancer mortality and allows for accurate localization of a polyp or mass during surgical intervention.² In the United States, the majority of colonoscopies are performed for colorectal cancer screening and surveillance by gastroenterologists.³ Pretreatment, colonic masses often are tattooed to ensure future identification of the lesion.

Treatment of challenging colonic lesions may be performed by an advanced endoscopic procedure with endoscopic mucosal resection (EMR) or endoscopic submucosal dissection, or the patient may be referred for surgical resection. Given the pattern of referral to other providers for resection of tattooed lesions, clear communication among teams who identify the lesion and those who will be surgically or endoscopically removing and/or following the site becomes important. This communication occurs largely through the endoscopy report.

Mucosal marking after polypectomy was first described in 1958 by Saunry and Knudtson.⁴ Colonic tattooing has

From the Department of Internal Medicine, Division of Gastroenterology, and the Department of Biostatistics and Bioinformatics, Duke University Medical Center, Durham, North Carolina.

Correspondence to Dr Joshua P. Spaete, Duke University Medical Center, Box 3913, Durham, NC 27710. E-mail: joshua.spaete@duke.edu. To purchase a single copy of this article, visit sma.org/smj-home. To purchase larger reprint quantities, please contact Reprintsolutions@wolterskluwer.com.

K.S.G. has received compensation from the National Institutes of Health. The remaining authors did not report any financial relationships or conflicts of interest.

Accepted November 19, 2018.

Supplemental digital content is available for this article. Direct URL citations appear in the printed text, and links to the digital files are provided in the HTML text of this article on the journal's Web site (<http://sma.org/smj-home>).

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0038-4348/0-2000/112-222

DOI: 10.14423/SMJ.0000000000000964

Key Points

- The majority of endoscopists do not report the number of tattoos placed, distance of the tattoo from the lesion, and location of the tattoo relative to the lesion of interest.
- A significant difference exists between the reported and actual number of tattoos placed by endoscopists.
- Previously placed colonic tattoos were seen in 75% of surgical resections and 73% of follow-up endoscopies. Despite only seeing a tattoo in 75% of cases, colonic lesions were successfully identified in 94% of surgical cases.

subsequently been integrated into practice as an effective technique to allow for the identification of colonic neoplasms during laparoscopic and open resection of colorectal masses.⁵ The most effective methods of marking lesions to aid in reidentification of the lesion at the time of removal remain unclear, however.

There are no published international consensus guidelines to assist in a standardization of tattoo application and technique. In the absence of a standardized consensus guideline, we hypothesized that tattooing technique varied between what providers reported and what was actually performed in practice. Furthermore, we anticipated variability among providers in tattooing techniques. To better understand current clinical practice, we proposed a retrospective chart review examining colonic tattooing technique and follow-up surgical and endoscopic procedures at our institution during the last 10 years. Concurrently, we developed a survey to define present practices regarding our approach to tattooing colonic polyps and neoplasms. We compared perceived clinical practice as self-reported by providers with actual clinical practice as determined by chart review. Our goal was to determine whether tattooing practice differed both from the recommendations in the literature and from what providers self-report and use these results to formulate an approach to tattooing practice that can be used by institutions until standard guidelines are available.

Methods

The study, which included both a chart review study and a survey of providers, was approved by the institutional review board of Duke University Medical Center. This approach allowed us to objectively assess what providers include in endoscopy reports when tattooing was performed and compare that with self-reported tattooing practice in the provider survey.

A 16-item survey instrument was developed to assess provider perceptions of tattooing practice. Questions were developed based on literature review, as well as focused discussions with academic gastroenterologists at Duke University Medical Center.

To determine the reliability and validity of the survey, the questions were piloted among a subset of gastroenterology fellows at Duke University Medical Center. Feedback was used by the study team, including statisticians familiar with survey development, to revise the content of the survey instrument.

Duke gastroenterologists and experienced trainees who perform colonoscopies were e-mailed an introduction to the survey with a link to a Web-based version of the survey. All first-year gastroenterology fellows were excluded because of a lack of experience with tattooing.

The final survey included questions that characterized endoscopic tattooing practice (Supplemental Digital Content, <http://links.lww.com/SMJ/A143>). Demographic variables were collected through the survey, including level of training, type of practice (general or advanced), and decade of training.

For the retrospective chart review, colonoscopy cases were identified by searching the Duke University Medical Center ProVation database (ProVation Medical, Minneapolis, MN) using the search parameters “procedure colonoscopy” and “maneuver injection” between dates spanning from January 1, 2005 to May 1, 2013. In total, 1630 charts were identified using these search parameters. These charts then were reviewed to determine the cases that met the inclusion criteria of unique patients aged 18 years and older who underwent colonoscopy at our institution with an injection of tattoo mark to identify a colonic lesion; 1235 unique patients were identified. Of these, 488 were excluded because the tattoos had been placed at an outside institution or an injection was performed that was not for the purpose of placing a tattoo. A total of 747 patients were included in the study.

From the 747 patients, 17 variables were gathered, including the patient’s age, sex, initial lesion on colonoscopy, initial resection if completed, faculty performing initial endoscopy, number of tattoo marks placed, location of initial lesion, site where the tattoo was placed, distance from the tattoo to the lesion, tattooing agent, adverse events following tattooing, type of follow-up, time to follow-up, lesion detected on follow-up, tattoo detected on follow-up, scarring at the time of EMR, and failure to complete an EMR because of scarring.

Study data were collected and managed using REDCap (Research Electronic Data Capture) electronic data capture tools hosted at the Duke Office of Clinical Research.⁶

Continuous variables were expressed as the mean, median, and range. The *t* test was used to compare the means of continuous variables. Categorical variables were expressed as frequency (percentage). Our primary comparison of interest was the difference in proportions of numbers of tattoo marks placed and the location of tattoo marks between self-reported practice (survey) and patient records by chart review. The χ^2 test or Fisher exact test was used for the comparisons of categorical variables between groups. The difference of the groups was claimed to be significant when the corresponding *P* value was <0.05. Analysis was performed in conjunction with a statistician. The statistical analysis was performed using SAS software version 9.4 (SAS Institute, Cary, NC).

Results

Twenty-five of 44 Duke gastroenterology faculty and senior fellows participated in the survey (56.8%). All of the respondents performed endoscopy at least one time per month. Three of the 25 providers surveyed had completed advanced endoscopy training.

In the retrospective chart review, 356 of the 747 included cases were women (48%). The mean and median patient age was 63 years and ages ranged from 19 years old to 7 patients who were older than 90 years.

Chart review revealed that several different types of colonic lesions were tattooed by providers at our institution. The most commonly tattooed lesions were sessile polyps, representing

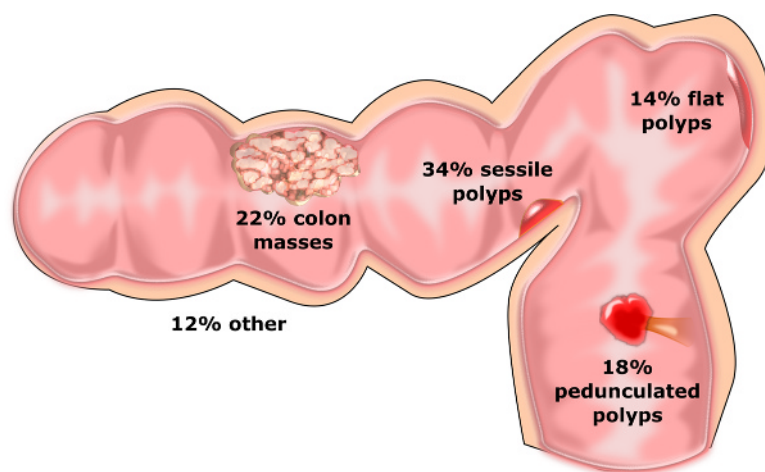


Fig. 1. Type of lesion tattooed as identified during chart review. Frequency of lesion type is indicated by percentage.

33.9% of the total followed by colonic masses (22%), as shown in Figure 1. Lesions were tattooed at sites throughout the colon, but the most common location of lesions that were tattooed was the ascending colon (35.6%), as represented in Figure 2.

The chart review revealed that tattooing was performed most commonly when no resection was attempted (47.8%) and for a range of anticipated resections. These included complete endoscopic resection of a lesion (30.2%), piecemeal resection (15.9%), and partial endoscopic resection of a lesion (6.0%).

Our institution transitioned to Spot (GI Supply, Mechanicsburg, PA) in 2012; during the course of the study, reports specified the use of India ink in 95% of cases and Spot was reported in 3% of cases.

Endoscopy reports rarely reported the number of tattoo marks placed (absent from 81.7% of reports) or the distance of tattoo marks from the lesion (absent from 95.7% of reports). When reported, only 56.2% of lesions were tattooed with 2 marks, and 43.8% were tattooed with 0 to 1 mark.

Although no association between the location of the lesion of interest or type of resection attempted and number of tattoo marks was observed, the type of lesion did influence the probability of the number of tattoo marks placed ($P < 0.01$). Providers placed ≥ 2 tattoo marks 72.1% of the time with colon masses compared with 41.9% of pedunculated lesions and 47.1% of flat or sessile polyps.

When we compared reporting practice over time, only 20 qualifying reports of tattooing were identified in the years 2003–2005; however, there was a marked increase to 112 reports of tattooing in 2006 followed by relatively consistent numbers of tattooing cases in subsequent years. When we evaluated the number of tattoo marks placed between 2006 and 2012, there did not appear to be an increase over time; 9.8% of reports specified placing 2 to 4 tattoo marks in 2006 compared with 9.5% of reports that specified placing 2 to 4 tattoo marks in 2012. The only case in which >4 tattoo marks were placed occurred in 2012.

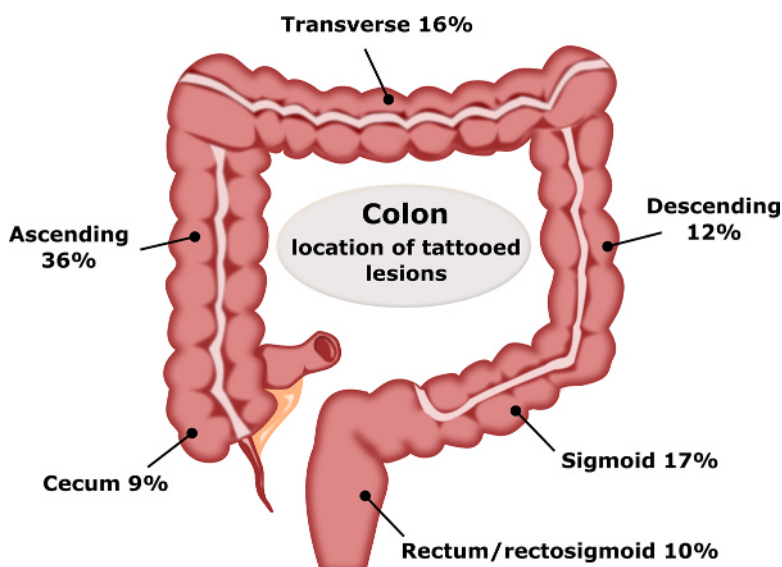


Fig. 2. Location of lesion tattooed as identified during chart review. Frequency of lesion location is indicated by percentage.

Table 1. Number of tattoos placed as identified during chart review compared with self-reported tattoo placement if endoscopic or surgical follow-up is anticipated

No. marks	Chart review (%)	Self-report endoscopy (%)	Self-report surgical follow-up (%)
>4	1 (7.3)	1 (4.3)	3 (12.5)
2-4	76 (55.5)	17 (73.9)	20 (83.3)
0-1	60 (43.8)	5 (21.7)	1 (4.2)
Total	137	23	24

The location of the tattoo mark(s) relative to the lesion often was not specified in the endoscopy report (78%). Of the 22% of cases in which a location was reported, a distal tattoo mark was the most common location (47.0%), followed by both proximal and distal tattoo marks (39.0%); a solo proximal tattoo was only placed 9% of the time. It was unusual for a tattoo mark to be placed directly underneath the lesion (1.8%), and similarly, a mark was placed opposite the lesion only 5.5% of the time.

For our primary outcome of interest, we identified important differences in provider perception of tattooing practice and the tattooing reported in endoscopy reports. Although chart review revealed that 55.5% of lesions were tattooed with 2 to 4 marks, in contrast, by survey, 87.2% of endoscopists reported routinely placing 2 marks ($P < 0.001$). The survey results also indicated that gastroenterologists self-reported placing 2 to 4 tattoo marks in 70.8% of cases in which flat polyps were identified or piecemeal resection was performed. Endoscopists also self-reported placing 2 to 4 tattoo marks in 83.3% of cases in which surgery was anticipated, as seen in Table 1.

To determine how tattoo placement and endoscopic reporting were associated with clinical outcomes, clinical follow-up after tattooing was assessed as a secondary outcome, and both type of follow-up and time to follow-up are noted in Table 2. Endoscopy was the most common method of follow-up after a lesion was tattooed. Follow-up after tattooing was most frequently accomplished by standard colonoscopy (60.0%) followed by surgical resection (33.2%) or advanced endoscopic procedure for EMR (5.4%).

Of note, despite the lack of clarity in endoscopy reports, colonic lesions were typically identified at the time of EMR or surgical follow-up with the lesion reported as identified in 94.0%

of operative notes and in 100% of cases with EMR follow-up. In comparison, lesions were only identified in 39.4% of follow-up colonoscopies, most likely related to the fact that lesions had been successfully removed at the index colonoscopy. Tattoo detection was similar at follow-up with detection in 75% of surgical resections and 73% of follow-up colonoscopies ($P = 0.53$).

In 70 instances, neither the tattoo nor the lesion was detected. Of these 70 cases, 67 were endoscopy cases and 3 were surgical cases. In the three surgical cases, neither the lesion nor the tattoo was definitively identified at the time of surgery and all three lesions were located in the cecum. In one of the three cases, the lesion that had been intended for surgical removal was not the lesion that had been tattooed at the time of colonoscopy. Despite lack of a tattoo mark identified, no change in surgical technique was reported for these cases, and in all of the cases, the intended lesion was included in successful cecal resection based upon final pathology.

The development of fibrosis precluding subsequent EMR is one potential adverse effect of tattooing, particularly when the tattoo is placed within the lesion. In our cohort, 35 patients underwent EMR following a previously placed colonic tattoo. In eight of these cases scarring was reported, with incomplete subsequent resection in seven cases (all had a prior attempted polypectomy). Scarring related to prior tattoo placement was not reported as a causative reason for incomplete resection.

As a secondary outcome, it is worth noting that adverse events were uncommon in association with colonic tattooing, as listed in Table 3. It was difficult to discern adverse events that were caused by a complex polypectomy versus adverse events related to tattoo placement itself. In four of five cases in which patients were admitted for pain, cross-sectional imaging was

Table 2. Type, mean, median, and range of follow-up for patients who underwent colonic tattooing

Type of follow-up	n	Mean time to follow-up, d	Median time to follow-up, d	Range of time to follow-up, d
Surgery	184	69.3	33	0-2924
EMR	30	115.4	99	17-308
Endoscopy	333	457.3	224	0-2597
>1	8	112.1	134.7	6-385
Overall	555	327.2	98	0-2924

EMR, endoscopic mucosal resection.

Table 3. Number of adverse events identified in patients who underwent colonic tattooing

No adverse events, %	98%
Fever (%)	1 (0.1)
Chills (%)	1 (0.1)
Significant bleeding (%)	5 (0.7)
Pain requiring hospitalization (%)	5 (0.7)
Perforation (%)	1 (0.1)

obtained and no evidence of peritonitis was observed. All of the cases were believed to be secondary to air insufflation.

Discussion

Tattooing colonic lesions has become standard practice when lesions need to be marked in anticipation of surgical intervention, future colonoscopic resection, or surveillance. The techniques used for colonic tattooing and the ways in which tattoo injection are reported vary widely, however. In a 1996 review,⁷ inconsistent tattooing practice was noted, and now, more than 20 years later, inconsistency remains a problem. Our study reveals that self-reported practice differs from what occurs in actual practice and highlights the need for better consensus and standardization of endoscopic tattooing technique. Although the literature has become clearer on recommendations for the documentation of tattooing, particularly for location of the tattoo mark relative to the lesion, we have shown that reporting practice does not meet this standard.⁸

Several studies support the fact that intraoperative identification of colonic lesions is easier when multiple tattoo marks are placed.^{7,9} In a surgical series of patients undergoing laparoscopic resection of a colonic lesion, 59% of patients had a tattoo visible and of help to the surgeon.⁹ In our series, a tattoo was reported more frequently at the time of surgery (75% of cases). Of note, no intraoperative endoscopy was required to identify the culprit lesion. These results support recommendations from prior studies regarding the benefit of multiple tattoos.

Our comparison of a practitioner survey and endoscopy reports indicates that perceptions of one's own practice may differ from actual practice for colonic tattooing. Gastroenterologists at our center self-reported placing ≥ 2 tattoos 96% of the time when surgical resection was anticipated, but this was inconsistent with endoscopy reports, in which ≥ 2 tattoo marks were placed in only 76% of cases. There are a number of possible reasons for this disparity, including an actual difference in practice, recall bias, changes in practice in the interval between the chart review and survey administration, as well as imprecise documentation in the endoscopy report with reliance on endoscopic images. When we compared documentation patterns during the years of chart review in the study, however, we found similar rates of reporting 2 to 4 tattoo marks between 2006 and 2012. As such, we suspect imprecise documentation accounted for much

of the difference between self-reported practice and what was reported in endoscopy reports. Although a picture may be worth a thousand words, endoscopists should be cognizant of the fact that images can readily be rendered incomprehensible by facsimile or electronic reproduction.

Clear communication is important in care across specialties and providers. Having an initial colonoscopy undertaken by the same surgeon who performs the follow-up operation has been associated with improved intraoperative localization of colonic tattoos.¹⁰ Because initial colonoscopy often is performed by a gastroenterologist with referral to a specialist, appropriate tattooing accompanied by a clear endoscopy report are likely to facilitate patient care. A published discussion of colonic tattooing implored endoscopists to provide details in the endoscopy report that specify the tattoo location relative to the lesion.⁸

We found that detail was lacking from the majority of endoscopy reports, with the number of tattoo marks missing from 81.7%, distance from the lesion missing from 95.7%, and the location of the tattoo mark(s) relative to the lesion absent in 78%. Because endoscopists often tattoo a lesion for surgical follow-up or future EMR that will be performed by a different provider, the original endoscopist may not receive feedback from other providers on the effectiveness of tattooing practice.

Although guidelines are still lacking regarding colonic tattooing, expert opinion recommends that all four quadrants of the colon be tattooed for a lesion that will be removed surgically, while fewer tattoo marks are needed for future endoscopic removal.⁸ When an operative resection is anticipated, it is preferable to tattoo distal to a lesion so that once identified, the surgeon can easily tell the relation of the tattoo to the tumor.⁸ Furthermore, placing the tattoo mark 3 to 4 cm distal to the lesion prevents fibrosis that can occur within the submucosa, which may limit future endoscopic resection, a particularly important consideration for anticipated EMR.⁸ In our cohort we observed that 20% of lesions sent for EMR posttattooing could not be removed because of scarring. If it is not believed that a polyp can be resected by the provider, then avoiding placement of a tattoo under the polyp and limiting endoscopic manipulation will facilitate resection at follow-up.

There are several limitations to this study. It was performed in a single academic tertiary medical center and may not be applicable to community practices. Cases were identified by searching our endoscopy database, which does not capture free-text entries, and relevant cases may not have been captured. Provider practice may have changed in the interval between the retrospective study and the administration of the provider survey. It should be noted that follow-up was not available in 192 cases.

Conclusions

Best colonic tattooing practice should be consistent among endoscopists. We favor placement of ≥ 2 tattoo marks 1-fold (3–4 cm) distal to a lesion. Use of a tattooing agent with few adverse effects such as Spot is suggested. Finding the submucosal

plane and injecting without going through the colon wall is optimal practice. Once the lesion has been tattooed, clear documentation is paramount. An important finding of this study is the general lack of documentation of the number of tattoo marks placed as well as the location of these marks. Our results also indicate that provider perceptions and actual practice may differ, suggesting the need for endoscopists to reconsider present practice and reporting patterns. Endoscopy reports may lack important details that may help a surgeon identify both the tattoo mark and the colonic lesion. Because of the lack of tattooing guidelines, providers are encouraged to develop standard practices for tattooing within an institution in discussion with consulting surgeons (Supplemental Digital Content, <http://links.lww.com/SMJ/A143>). Next, clear documentation stating the number of marks placed and the relation (preferably distal) to the lesion should be performed as part of standard endoscopic reporting. Teaching optimal tattooing technique and proper documentation should be a standard part of endoscopic training.

Acknowledgment

The authors thank Richard von Furstenberg for assistance in creating Figures 1 and 2.

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