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The Disappearance of India Ink.

Fiedler LM, Wayne JD, Harpaz N, Henry D, Janowitz Division of Gastroenterology and Division of Pathology, Mount Sinai Medical Center, New York, NY

Introduction: Commercially available India ink has been used by endoscopists to mark or “tattoo” lesions for subsequent surgery or endoscopy since 1975. In an attempt to reduce the possibility of inflammation and microabscess formation within the gut wall, the ink is diluted and sterilized by autoclave or passing it through millipore filters. We report on a new purified and sterilized preparation of carbon black, the agent in India ink, in a suspension with reduced levels of polycyclic aromatic hydrocarbons.

Materials and Methods: Following IRB approval, up to 10 cc of carbon black (Spot, GI Supply) was injected into the colon wall in 55 patients who had lesions which raised concern for subsequent surgery. Three or 4 circumferential injections were given. Patients were referred for either surgical or endoscopic followup on a case by case basis after histological analysis of the lesions.

Results:

Location of Marker: In the event of surgical resection, histopathology from the injection site was evaluated. The sites of injection were right colon, 22; transverse colon, 5; left colon, 21; 8 had lesions marked within 20 cm of the anal verge.

Indication for Marker: Thirty seven patients had subsequent endoscopic followup to ensure complete removal of large or difficult to localize polyps (such as those on the proximal side of a

colonic fold only visible with retroflexion). Eighteen patients had marking for surgical followup for either polyps not amenable to endoscopic removal or obvious cancer.

Pathology: Ten of the fifty six carbon black injections had surgery at our institution and thus were available for histological inspection. All slides were reviewed by a single pathologist. Ink was distributed transmurally in 7 patients and submucosally in 3 patients. Acute inflammation (moderate) was documented in 1, chronic inflammation in 5 specimens (2 mild, 3 moderate), and fibrosis (3 mild, 1 moderate, 1 severe) was noted in 4. There was no necrosis in any specimen.

Complications: There were no perforations or endoscopic complications in this series. No patient reported abdominal pain, discomfort, or fever after endoscopy.

Conclusion: A new endoscopic marker has been developed. It is sterile and pre-diluted and is devoid of clinical side effects. It should replace commercial India ink which contains shellac, phenol, ammonia, and other unknown and proprietary chemicals

Idiopathic inflammatory bowel disease associated with colonic tattooing with India ink preparation-case report and review of literature.

Gopal DV, Morava-Protzner I, Miller HA, Hemphill DJ. *Gastrointest Endo* 1999;49:636-9

Endoscopic tattooing with India ink has been used to mark small lesions or polypectomy sites for subsequent intraoperative localization and to identify polypectomy sites for endoscopic follow-up.[1] It provides a long-lasting stain, ensures prompt and accurate localization at surgery, and has only rare complications,[2] including symptomatic serosal inflammation[3] and colonic perforation, observed at laparotomy.[4] Asymptomatic complications include fat necrosis with inflammatory pseudotumor formation,[5] colonic abscess with localized peritonitis,[6] mild chronic inflammation,[7] and phlegmonous gastritis with a mild inflammatory infiltrate.[8] We describe a case of idiopathic inflammatory bowel disease occurring as a result of colonic tattooing with India ink.

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Inflammatory bowel disease after India ink tattooing: too much of a good thing.

Shatz BA, Weinstock LB, Thyssen EP. *Gastrointest Endo* 2000;51:253

To the Editor:

We read with great interest the case report and review of the literature by Gopal et al.[1] concerning inflammatory bowel disease after colonic tattooing with India ink. The authors injected a total of 4.0 mL of undiluted, unfiltered India ink of unstated sterility. Their reported complication was not seen in our 15-year reported experience with India ink tattooing which the authors did not include in their review of the literature. We have stressed the importance of using properly diluted, filtered, and sterilized India ink and the success of small volume (0.1 mL) tangential injections in 2 to 3 sites.[2-4] In our retrospective study of 134 patients there were no clinical complications.[3] In our prospective study, 74 biopsy specimens were obtained from tattoos that had been placed an average of 36 months before biopsy (range 1.5 to 117 months).[4] No infections, abdominal pain, diarrhea or any endoscopic abnormalities occurred in any of the 48 patients. There was a mild degree of chronic inflammation at 6 endoscopically normal tattoo sites and hyperplastic change secondary to polypectomy at one site. Before our reports, there were no endoscopic abnormalities described in 225 patients and only two cases of mild chronic inflammation seen in 7 biopsies of tattoos. In a recent study there were no clinical complications in 195 patients who were given 0.2 to 0.5 mL diluted, filtered India ink tattoos in 4 quadrants.[5] Reported cases with complications such as intramural abscess and peritonitis occurred after large-volume ink injections.[6,7]

The case report of Gopal et al. again points up the problem that a standardized, tested India ink tattoo suspension has not been commercially available. India ink preparations have usually been made by

hospital pharmacists using various techniques and this makes it difficult to interpret complications and compare results from different institutions.

India ink solutions (Micropigmentation Devices, Inc., Edison, N.J.) and filter injection kits (Hobbs Medical, Inc., Stafford Springs, Conn.) have been marketed and used for colonic tattooing. However, these preparations have not been clinically tested and are not FDA approved. After clinical testing, they may provide standardized, commercially available, safe tattoo mediums if administered in the correct manner. In the case reported by Gopal et al., the undiluted, unfiltered, large-volume India ink injections of unstated sterility may have triggered the immunologic and clinical response. It is to the authors credit that they discussed this possibility.

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Endoscopic Tattooing of the Colon: Clinical Experience.

Hammond DC, Lane FR, Mackeigan JM, Passinault WJ. *Am Surgeon* 1993;59:205-10

Nonpalpable lesions of the colon can be difficult to locate intraoperatively. We have demonstrated in an experimental study in dogs that the colon can be endoscopically "tattooed" by injecting dye through a flexible needle into the wall of the colon. At laparotomy, the resulting "tattoo" is then visible on the serosal surface of the bowel. This technique allows precise surgical localization of endoscopically identified lesions simply by visualizing the dye. Our initial clinical experience tattooing 15 colonic lesions in 12 patients is presented. In all patients, the endoscopically injected dye (1 percent indocyanine green) was easily visualized on the serosal surface of the colon at surgery. The dye remained at the site of injection for at least 36 hours allowing tattooing to be performed the day before surgery. No significant complications were encountered with only one patient developing an inflammatory reaction at the site of injection. This experience demonstrates the clinical utility of endoscopic tattooing of the colon to permit accurate intraoperative localization of small or nonpalpable lesions.

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Endoscopic Tissue Staining and Tattooing.

Technology Assessment Committee, David L. Carr-Locke, Chair M.D. , et al., American Society for Gastrointestinal Endoscopy

Background: Many different stains have been described for use singly or in combinations prior to or during endoscopy (Table 1)[1]. Endoscopic tissue staining or dye spraying refers to the topical application of chemical stains or pigments to alter tissue appearances in order to improve localization, characterization, or diagnosis. Tattooing is a means of permanently labeling a site in the gastrointestinal tract by intramural injection of a pigment for future identification.

Summary: Endoscopic tissue staining has been available for many years. Lugol's solution and toluidine blue have utility for the diagnosis of occult esophageal squamous cell carcinoma in high risk patients. The other stains remain as research tools but have limited clinical application at the present time. Endoscopic tattooing appears to be a safe and clinically useful tool.

Colonic Tattooing with India Ink: Benefits, Risks and Alternatives.

Nizam R, Siddiqi N, Landas SK, Kaplan DS, Holtzaple PG. Am J Gastroenterol 1996;91:1804-8

Objective: To provide comprehensive information on key issues concerning colonic tattooing with India ink in reported literature.

Methods: A total of 735 citations on India ink alone were present in the English literature (1966-1995), including 16 on India ink and colonic tattooing. Nine major studies were identified and reviewed for 1) preparation before tattooing (type of ink used, sterilization process, colonic preparation, and antibiotic prophylaxis), 2) the tattooing process (technique and volume injected), 3) success in localization, and 4) complications.

Results: A total of 447 cases of colonic tattooing with India ink have been reported. Major indication was preoperative marking of tumor site. Various India ink preparations were used. Ink was unsterilized in 57% (255/447), autoclaved in 42% (187/447), and gas sterilized in 1% (5/447) of cases. Colonic preparation varied similarly. Prophylactic antibiotics were used in 1% (5/447) of cases. Dilution of India ink varied from undiluted to 1:100 (with 0.9% saline). The volume injected ranged from 0.1 to 2 ml per site injected, commonly with tangential needle insertion and delivery of ink into the submucosa in the majority of the cases. Intraoperative localization was easier with multiple tattoo injections. Five reports of complications have been made. In only one instance did overt clinical complications develop. Risk of a clinical complication with colonic tattooing with India ink is 0.22%.

Conclusion: Marked variability in technique, as well as potential for reporting bias, limit the quantitative conclusions. In general, colonic tattooing with India ink is a safe, accurate, and inexpensive method for preoperative marking and prospective study of colonic lesions.

MRI Interaction with Tattoo Pigments: Case Report, Pathophysiology, and Management.

Kreidstein ML, Giguere D, Freiberg A Plast Reconstr Surg 1997;99:1717-20

Abstract: A case is reported in which the presence of a decorative tattoo resulted in pain and termination of an **MRI** study. The ferromagnetic nature of the tattoo and iron oxide tattoo pigments is demonstrated. The pathophysiology of tattoo/**MRI** interaction is discussed, as is an approach to the prevention and treatment of this complication.

India Ink Tattooing in the Esophagus.

Shaffer RT, et al. Gastrointest Endosc 1998;47:257-60

Background: Precise endoscopic measurement of esophageal landmarks is difficult and inaccurate because of the ability of the esophagus to lengthen and foreshorten.

Methods: Nineteen patients enrolled to date in a study of Barrett's esophagus had an **India ink** tattoo placed at the most proximal level of the squamocolumnar junction and were examined endoscopically at 3, 9, 15, 24, and 36 months.

Results: Eighteen of nineteen patients (94.7%) were judged to have a good to excellent tattoo persistence at 3 months. One of the 19 patients (5.3%) had poor tattoo persistence and was retattooed at the 3-month interval. Eventually, 15 of the 15 patients (100%) who remained in the study had a good or excellent tattoo persistence at 36 months. There were no complications related to **India ink** tattooing including chest pain, bleeding, or perforation. At follow-up endoscopy, no ulcers, inflammation, break in the mucosa, or pain were noted.

Conclusion: **India ink** tattooing in the esophagus is safe and persistent and may be used as an effective method for longitudinal follow-up of lesions in the esophagus.

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India Ink Colonic Tattoo: Blots on the Record (editorial).

Lightdale CJ. *Gastrointest Endosc* 1991;37:99-100

Endoscopic India ink tattooing of the colon was first described by Ponsky and King[1] in 1975 in this journal. The method has subsequently been advocated by experts as the best available means to mark the site of a colonic lesion pre-operatively.[2] In this issue, there are two new reports promoting colonoscopic India ink injection. Hyman and Waye[3] describe four-quadrant injection to facilitate operative localization, and Shatz and Thavorides[4] describe the use of two injections to "bracket" a polypectomy site for subsequent colonoscopic inspection. There were no complications in 40 patients receiving four quadrant injections or in 64 patients receiving two injections. Shatz and Thavorides[4] describe an inadvertent peritoneal injection in one patient without evident ill effect at laparotomy 5 days later.

It came as a shock, therefore, to receive almost simultaneously two well-documented reports of complications following colonoscopic India ink injection in three patients, which also appear in this issue.[5,6] Reported untoward effects include fat necrosis, inflammatory pseudotumor, abscess, and focal peritonitis. Previous reports of complications were qualified: one occurred after an injection into the stomach wall[7] and the other involved a canine model where the ink was mixed with alcohol.[8]

The reasons for the complications described by Coman et al.[5] and Park et al.[6] in this issue are not clear. Both groups of investigators took pains to carefully autoclave the ink and used small injection volumes. Injection sites, of course, cannot be sterilized, but the problem may relate to the ink rather than the technique of injection.

Even the earliest references to India ink indicate it is more than a suspension of carbon particles in water; to make India (also called China) ink, lampblack was bound by various gums and pastes.[9] British author Rudyard Kipling, who believed he wrote best only with the blackest ink, "would have kept an ink-boy to grind me Indian ink." [10]

Modern commercial India inks consist primarily of carbon particles and water, but also contain a wide variety of organic and inorganic compounds used as carriers, stabilizers, binders, and fungicides.[11,12] Does autoclaving these chemical soups result in additional substances capable of eliciting an inflammatory or allergic response?

In their report, Hyman and Waye[3] emphasize that more experience is needed with these methods before the incidence of adverse effects can be defined. The need to mark an area of colon after removal of large or possibly malignant polyps is real. Of all methods tried so far, India ink injection seems the most promising. Hopefully, complications such as those reported in this issue will be infrequent. Continued cautious use of India ink in selected patients would not seem unreasonable. Perhaps, like Kipling, those performing colonoscopic tattoo should grind their own, or at least seek a more pure carbon suspension than commercial inks provide. Additional studies in controlled settings are certainly warranted, and the search for improved methods of marking a colonic polypectomy site should be intensified.