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Structured versus non-structured reporting of pelvic MRI for ileal pouch evaluation: clarity and effectiveness

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Abstract

Purpose Given that ileal pouch-anal anastomosis (IPAA) surgery is a technically challenging and high-morbidity procedure, there are numerous pertinent imaging findings that need to be clearly and efficiently communicated to the IBD surgeons for essential patient management and surgical planning. Structured reporting has been increasingly used over the past decade throughout various radiology subspecialties to improve reporting clarity and completeness. We compare structured versus non-structured reporting of pelvic MRI for ileal pouch to evaluate for clarity and effectiveness.

Methods 164 consecutive pelvic MRI's for ileal pouch evaluation, excluding subsequent exams for the same patient, acquired between 1/1/2019 and 7/31/2021 at one institution were included, before and after implementation (11/15/2020) of a structured reporting template, which was created with institutional IBD surgeons. Reports were assessed for the presence of 18 key features required for complete ileal pouch assessment: anastomosis (IPAA, tip of J, pouch body), cuff (length, cuffitis), pouch body (size, pouchitis, stricture), pouch inlet/pre-pouch ileum (stricture, inflammation, sharp angulation), pouch outlet (stricture), peripouch mesentery (position, mesentery twist), pelvic abscess, peri-anal fistula, pelvic lymph nodes, and skeletal abnormalities. Subgroup analysis was performed based on reader experience and divided into three categories: experienced ($n=2$), other intra-institutional ($n=20$), or affiliate site ($n=6$).

Results 57 (35%) structured and 107 (65%) non-structured pelvic MRI reports were reviewed. Structured reports contained 16.6 [SD:4.0] key features whereas non-structured reports contained 6.3 [SD:2.5] key features ($p<.001$). The largest improvement following template implementation was for reporting sharp angulation of the pouch inlet (91.2% vs. 0.9%, $p<.001$), tip of J suture line and pouch body anastomosis (both improved to 91.2% from 3.7%). Structured versus non-structured reports

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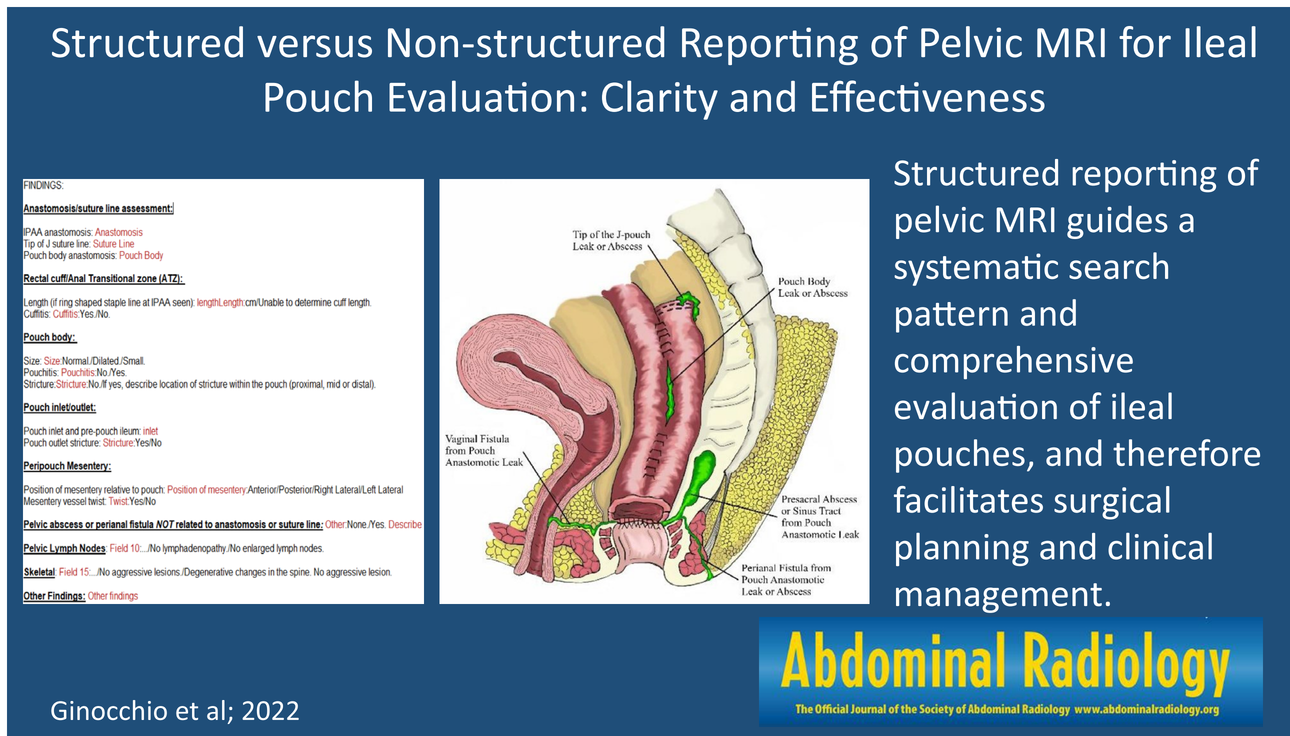
contained mean 17.7 versus 9.1 key features for experienced readers, 17.0 versus 5.9 for other intra-institutional readers, and 8.7 versus 5.3 for affiliate site readers.

Conclusion Structured reporting of pelvic MRI guides a systematic search pattern and comprehensive evaluation of ileal pouches, and therefore facilitates surgical planning and clinical management. This standardized reporting template can serve as baseline at other institutions for adaptation based on specific radiology and surgery preferences, fostering a collaborative environment between radiology and surgery, and ultimately improving patient care.

Graphical abstract



Keywords Structured reporting · Inflammatory bowel disease · Pelvic MRI · Standardized reporting · Ileal pouch

Introduction

Ileal pouch-anal anastomosis (IPAA) surgery is the gold standard surgical procedure for the treatment of medically refractory ulcerative colitis and for patients with familial adenomatous polyposis [1–3]. Although considered a relatively low mortality surgery, the technical challenges of the procedure can result in a complication rate of up to 60% [4]. Pelvic MRI is often performed for ileal pouch evaluation, usually in the non-acute setting. Symptomatic indications include (a) patients presenting with symptoms of pouch dysfunction, b) those undergoing evaluation for pouch revision [5], and (c) evaluation prior to pre-ileostomy takedown for those that have undergone pouch revision often in conjunction with water soluble contrast enema [6]. Given that ileal pouch-anal anastomosis (IPAA) surgery is a technically challenging and high-morbidity procedure, there are numerous pertinent imaging findings that need to be clearly and efficiently communicated to the IBD surgeons for essential patient management and surgical planning.

One frequently encountered issue with radiology reporting is the inconsistency in report format. Non-structured report formatting can often lead to incomplete or unclear reporting [7]. This frequently prompts requests from the surgical team for additional information or clarification [8]. In addition, report clarity has been shown to correlate with radiologist experience and familiarity with institutional surgeon preferences. Ideally, a radiology report should be clear, adaptable, and succinct, while still including all necessary information [9]. To assist in this endeavor, structured reporting has been increasingly used over the past decade and its importance recognized throughout many radiology subspecialties [10–14]. Structured reports ensure the pertinent positive and negative

findings are included in the initial radiology report, and also serve as a check to ensure all important aspects of the study are assessed [15]. Referring clinicians have been shown to prefer structured reports for radiology studies as opposed to conventional narrative reports, due to the perceived improved clarity [16, 17]. The Radiological Society of North America (RSNA) has recognized the significance of standardized reporting, and has created the radiology reporting initiative to develop a library of clear and consistent report templates, in an effort to improve reporting practices throughout the country [18].

A pelvic MRI structured reporting template for ileal pouch imaging was developed through collaboration between the abdominal radiology division and the inflammatory bowel disease (IBD) surgeons in 2020 [19]. The template focuses on specific information relative to surgical planning and includes assessment of 18 key features required for complete ileal pouch assessment: anastomosis/suture line assessment (IPAA, tip of J, pouch body), cuff (length, cuffitis), pouch body (size, pouchitis, stricture), pouch inlet/pre-pouch ileum (stricture, inflammation, sharp angulation), pouch outlet (stricture), peripouch mesentery (position, mesentery twist), pelvic abscess, peri-anal fistula, pelvic lymph nodes, and skeletal abnormalities. This standardized reporting template was implemented across our main campus and multiple affiliate sites on November 15, 2020, and was designed to be readily available to all users in the dictation software by selecting from a list of all-site macros, to allow for easy use.

The purpose of our study is to compare structured versus non-structured reporting of pelvic MRI for ileal pouch evaluation at our institution in terms of clarity and completeness of ileal pouch pelvic MRI reporting.

Methods

Patients

This study was Institutional Review Board (IRB) approved with waiver of informed consent and Health Insurance Portability and Accountability Act (HIPAA) compliant. A retrospective departmental database search was performed identifying MRI radiology reports containing "J pouch" or "Ileal pouch" (close match, not exact) between 1/1/2019 and 7/31/2021.

Radiology report review and analysis

MRI reports were assessed for the presence of 18 key imaging features required for complete ileal pouch assessment, including anastomosis (IPAA, tip of J, pouch body), cuff (length, cuffitis), pouch body (size, pouchitis, stricture), pouch inlet and pre-pouch ileum (stricture, inflammation, sharp angulation), pouch outlet (stricture), peripouch mesentery (position, mesentery twist), pelvic abscess not related to anastomoses, peri-anal fistula, pelvic lymph nodes, and skeletal abnormalities. This assessment was conducted by one author in the study, who although was not involved in the initial study design and creation, did assist in the data analysis and manuscript creation. Figure 1 illustrates IPAA surgical site leaks and associated sinus tracts, fistulas, and abscesses. Subgroup analysis was performed based on reader experience divided into three categories: experienced readers ($n=2$), other intra-institutional ($n=20$), or affiliate site ($n=6$). For the purpose of this study, experienced readers were defined as the two abdominal radiologists who had the most experience interpreting pelvic MRI for ileal pouch assessment in the department and also were most involved in creation of the standardized template. Other intra-institutional readers were defined as other abdominal radiologists at the main campus, while affiliate site readers were defined as any abdominal radiologist at a site other than the main campus.

To assess the effectiveness of structured versus non-structured reporting, the institutional medical record was searched for exam under anesthesia (EUA) or intraoperative findings within 30 days of the patient's pelvic MRI, with those findings designated as the gold standard of assessment. Clinically significant missed findings were defined as findings present on EUA or intraoperatively that were not reported on pelvic MRI, which required subsequent surgical

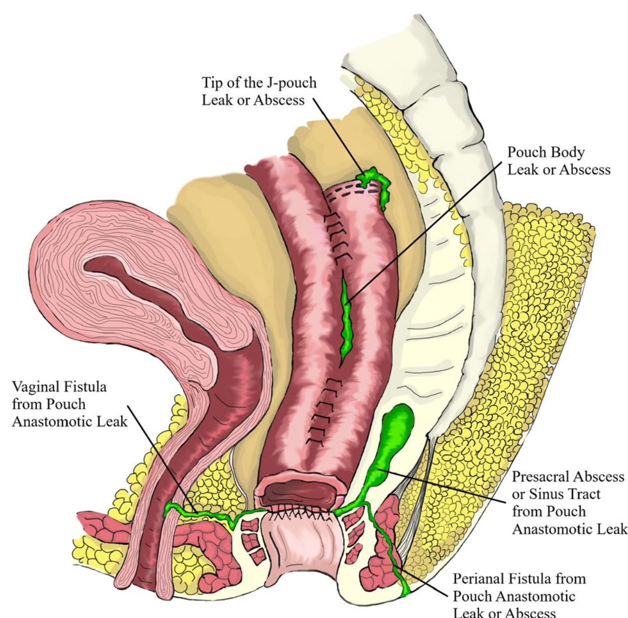


Fig. 1 Ileal pouch-anal anastomosis surgical site leaks and associated sinus tracts, fistulas, and abscesses

intervention (pouch inlet/outlet stricture, mesentery twist, sharp angulation, or anastomotic leak).

Statistical analysis

The Mann–Whitney U test was used to compare the average number of key features present in the structured and non-structured reports, both in the overall and subgroup analyses, and was also used to compare patient ages in the two report groups. Fisher's exact test was used to compare each individual key feature present in the structured and non-structured reports and to compare the number of missed findings in non-structured and structured reports. A *p*-value < 0.05 indicated statistical significance. Analysis was performed using Excel for Windows (Microsoft, Redmond, Washington).

Results

Patients

164 consecutive MRI studies for ileal pouch evaluation, excluding subsequent exams for the same patient (25 structured and 28 non-structured reports excluded), between 1/1/2019 and 7/31/2021 at our institution before and after implementation (11/15/2020) of the structured reporting template were included, consisting of 107 (65%) non-structured reports obtained between 1/1/2019 to 11/1/2020 and 57 (35%) structured reports obtained between 12/1/2020 to 7/31/2021. Figure 2 demonstrates how the template appears to users in the dictation software. Analysis of patient ages demonstrated a mean ± standard deviation patient age in the non-structured report cohort of 42 ± 14 years versus 43 ± 14 years in the structured report cohort (p = 0.919).

Imaging report analysis

Structured reports contained a mean of 16.6 ± 4.0 (range 3–18) key features and non-structured reports contained 6.3 ± 2.5 (range 3–18) key features ($p < 0.001$) (Table 1).

The distribution of reports interpreted by readers of each experience level is described in Table 2. Of the twenty eight total readers, four readers (2 experienced, 1 other intra-institutional, 1 affiliate site) interpreted four or more studies both before and after template implementation. On subgroup analysis of key features, experienced readers' reports contained a mean of 17.7 ± 0.5 versus 9.1 ± 2.8 ($p < 0.001$), other intra-institutional readers' reports contained 17.0 ± 3.6 versus 5.9 ± 2.0 ($p < 0.001$), and affiliate site readers' reports contained 8.7 ± 6.6 versus 5.3 ± 0.8 ($p = 0.69$), on structured reports versus non-structured reports, respectively (Table 2).

Multiple key features were not frequently reported in the non-structured reports, and the largest improvement following template implementation was for reporting whether there was sharp angulation of the pouch inlet, from 1 of 107 (0.9%) to 52 of 57 (91.2%), in the non-structured and structured reports, respectively ($p < 0.001$) (Table 3).

22 non-structured reports contained any missed findings versus 8 structured reports (22/107 [20.5%] vs 8/57 [14.0%], $p = 0.40$), of which, missed findings in 9 non-structured reports and 2 structured reports were clinically significant, as detailed in Table 4. The clinically significant findings detected by each reader experience category are detailed in Table 5. Subgroup analysis based on reader experience was performed for clinically significant missed findings, defined

FINDINGS:

Anastomosis/suture line assessment:

IPAA anastomosis: Anastomosis
Tip of J suture line: Suture Line
Pouch body anastomosis: Pouch Body

Rectal cuff/Anal Transitional zone (ATZ):

Length (if ring shaped staple line at IPAA seen): lengthLength:cm/Unable to determine cuff length.
Cuffitis: Cuffitis:Yes./No.

Pouch body:

Size: Size:Normal./Dilated./Small.
Pouchitis: Pouchitis:No./Yes.
Stricture:Stricture:No./If yes, describe location of stricture within the pouch (proximal, mid or distal).

Pouch inlet/outlet:

Pouch inlet and pre-pouch ileum: inlet
Pouch outlet stricture: Stricture:Yes/No

Peripouch Mesentery:

Position of mesentery relative to pouch: Position of mesentery:Anterior/Posterior/Right Lateral/Left Lateral
Mesentery vessel twist: Twist:Yes/No

Pelvic abscess or perianal fistula *NOT* related to anastomosis or suture line: Other:None./Yes. Describe

Pelvic Lymph Nodes: Field 10:.../No lymphadenopathy./No enlarged lymph nodes.

Skeletal: Field 15:.../No aggressive lesions./Degenerative changes in the spine. No aggressive lesion.

Other Findings: Other findings

Fig. 2 Structured reporting template

Table 1 Overall analysis of key features in structured vs. non-structured reports

Report	Key features (mean ± SD)	Range	*p* value
Structured	16.6 ± 4.0	3–18	< .001
Non-structured	6.3 ± 2.5	3–18	

Table 2 Subgroup analysis of key features in reports and total number of reports assessed based on reader experience

Reader experience (N)	Structured (mean ± SD) [N]	Non-structured (mean ± SD) [N]	*p* value
Experienced readers (2)	17.7 ± 0.5 [35]	9.1 ± 2.8 [21]	< .001
Other institutional readers (20)	17.0 ± 3.6 [16]	5.9 ± 2.0 [78]	< .001
Affiliate site readers (6)	8.7 ± 6.6 [6]	5.3 ± 0.8 [8]	.69

Table 3 Comparison of key feature frequency of reporting

Key feature	Structured ($n=57$)	Non-structured ($n=107$)	p value
IPAA anastomosis	54 (94.7%)	32 (29.9%)	< .001
Tip of J anastomosis	52 (91.2%)	4 (3.7%)	< .001
Pouch body anastomosis	52 (91.2%)	4 (3.7%)	< .001
Cuff length	48 (84.2%)	15 (14.0%)	< .001
Cuffitis	51 (89.5%)	14 (13.1%)	< .001
Pouch body size	53 (93.0%)	36 (33.6%)	< .001
Pouchitis	54 (94.7%)	88 (82.2%)	.025
Pouch body stricture	52 (91.2%)	16 (15.0%)	< .001
Pouch inlet structure	52 (91.2%)	23 (21.5%)	< .001
Pouch inlet inflammation	52 (91.2%)	22 (20.6%)	< .001
Pouch inlet sharp angulation	52 (91.2%)	1 (0.9%)	< .001
Pouch outlet stricture	52 (91.2%)	11 (10.3%)	< .001
Peripouch mesentery position	52 (91.2%)	14 (13.1%)	< .001
Peripouch mesentery twist	52 (91.2%)	6 (5.6%)	< .001
Pelvic abscess	54 (94.7%)	88 (82.2%)	.025
Perianal fistula	54 (94.7%)	89 (83.2%)	.035
Pelvic lymph nodes	56 (98.2%)	106 (99.1%)	.649
Sacroilitis	53 (93.0%)	107 (100%)	.094

as requiring subsequent surgical intervention (Table 6), with experienced readers reports containing missed clinically significant findings in 5.7% versus 9.5% ($p=0.63$), other intra-institutional readers in 0% versus 9.0% ($p=0.60$), and affiliate site readers in 0% versus 0% ($p=1$), on structured reports versus non-structured reports, respectively. Overall, non-structured reports had associated EUA/surgery follow-up within 30 days for 76/107 studies, whereas structured reports had the equivalent follow up for 40/57 studies.

Of the 57 reports analyzed post template implementation, 5 reports were free-dictated without use of the template or codified nomenclature. Of these 5 reports, 4 were by affiliate site readers and 1 by an other intra-institutional reader. Analysis of the remaining 52 reports post-template implementation demonstrated there were 4 fields which were deleted in one or more reports (cuff length 4/52, cuffitis 1/52, pouchitis 1/52, and sacroiliitis 4/52). For the 4 reports which excluded the cuff length field of the report, 2 involved a hand sewn IPAA status post mucosectomy.

Example cases from our study population of missed sharp pouch angulation and mesentery twist are presented in Figs. 3 and 4, respectively. An additional example case is presented in Fig. 5, where a tip of J leak was not prospectively identified on the preoperative MRI, but was correctly classified at the retrospective reading (Please note, that given that there were no missed tip-of-J leaks in the reports included in our study, this is an example

Table 4 Clinically significant missed findings by each reader experience category

Finding	Experienced		Other institutional		Affiliate site	
	Structured	Non-structured	Structured	Non-structured	Structured	Non-structured
Pouch outlet stricture	0	1	0	2	0	0
Mesentery twist	2	1	0	4	0	0
Sharp angulation	0	0	0	1	0	0
Total	2	2	0	7	0	0

Table 5 Clinically significant findings detected by each reader experience category

Finding	Experienced		Other institutional		Affiliate site	
	Structured	Non-structured	Structured	Non-structured	Structured	Non-structured
IPAA anastomosis leak	2	4	1	7	0	0
Pouch outlet stricture	5	2	3	3	0	0
Mesentery twist	3	1	1	0	1	0
Pouch inlet stricture	0	1	1	1	0	0
Sharp angulation	0	0	0	1	0	0
Tip of J anastomosis leak	0	0	1	0	0	0
Total	10	8	7	12	1	0

Table 6 Comparison of clinically significant missed findings by each reader experience category

Reader experience	Structured	Non-structured	*p* value
Experienced readers	2/35 (5.7%)	2/21 (9.5%)	.63
Other institutional readers	0/16 (0%)	7/78 (9.0%)	.60
Affiliate site readers	0/6 (0%)	0/8 (0%)	1

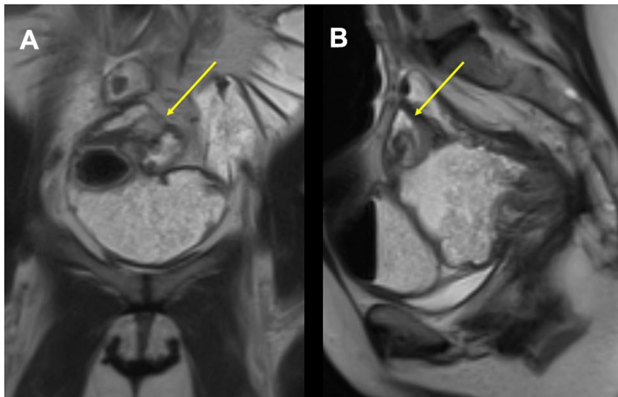


Fig. 3 Missed diagnosis of sharp angulation due to incomplete pouch assessment with non-structured report. 51 year-old female with ulcerative colitis status post J-pouch underwent contrast enhanced pelvic MRI for pelvic pain. Coronal (**a**) and sagittal (**b**) T2-weigthed images from pre-operative pelvic MRI demonstrates an unreported sharp pouch angulation, which was discovered intraoperatively

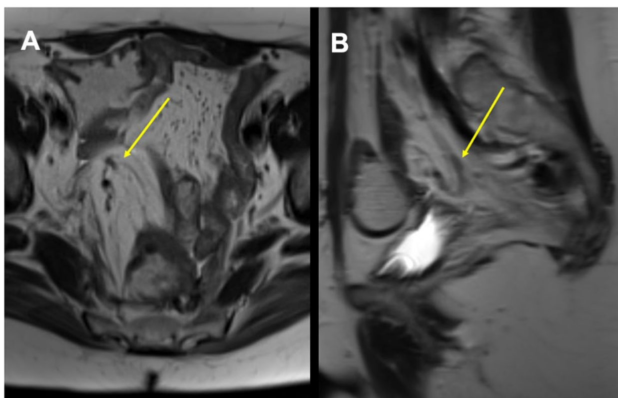


Fig. 4 Missed diagnosis of mesentery twist due to incomplete pouch assessment with non-structured report. 47 year-old female with ulcerative colitis status post J-pouch underwent contrast enhanced pelvic MRI for pelvic pain. Axial (**a**) and sagittal (**b**) T2-weigthed images from pre-operative pelvic MRI demonstrates an unreported mesenteric twist, which was discovered intraoperatively

reference case from our institution prior to the start date of 1/1/2019).

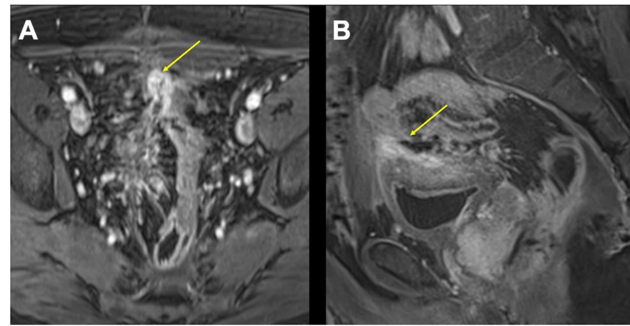


Fig. 5 Missed diagnosis of tip-of-J leak due to incomplete pouch assessment with non-structured report (Please note, given that there were no missed tip-of-J leaks in the reports included in our study, this is an example reference case from our institution prior to the study start date of 1/1/2019). 52 year-old male with Crohn's disease status post J-pouch underwent contrast enhanced pelvic MRI for pelvic pain. Axial (**a**) and sagittal (**b**) post contrast T1-weigthed images from pre-operative pelvic MRI demonstrates an unreported tip of J leak. The pre-operative non-structured MRI report read "Inflammation and abscess associated with a loop of small bowel and bladder dome, and extending toward the abdominal wall, suspicious of Crohn's disease." However, further review with an experienced radiologist identified this as tip of J leak which was subsequently confirmed on laparotomy. Tip of J suture line is one of the most neglected parts of routine search pattern on non-structured reporting

Discussion

Our study confirmed that using structured reporting templates significantly increased the number of reported features amongst readers of all levels of experience, whereas non-structured narrative reports frequently omitted multiple key features required for comprehensive ileal pouch assessment. Indeed, nearly all (16/18) of the analyzed key features demonstrated significantly increased reporting frequency following template implementation. However, there was no statistically significant difference in reporting of clinically significant findings with or without the structured report template, regardless of radiologist experience. This indicates that although the structured report ensured comprehensive reporting, radiologists still identified clinically significant findings without the template.

The largest improvement in key feature reporting following template implementation was for reporting whether or not there is sharp angulation at the pouch inlet, which increased from 1 of 107 (0.9%) in the non-structured to 52 of 57 (91.2%) in the structured reports. In addition, tip of the J suture line (improved from 3.7 to 91.2%) and pouch body anastomosis (improved from 3.7 to 91.2%) demonstrated significant improvement in reporting following structured template adoption. These areas may have been previously neglected in a typical search pattern when interpreting pelvic MRI for ileal pouch assessment, and provide areas for targeted education. Tip of the J assessment in particular is

critical for comprehensive ileal pouch imaging assessment, as leaks at this location are often overlooked and require a high index of suspicion. Indeed, the observation of a non-statistically significant difference of included key features between experienced and other intra-institutional readers following template implementation highlights the idea that radiologists throughout a department, regardless of experience, can be brought up to an experienced level of interpretation through a combination of structured reporting and ongoing education.

The two most common clinically significant missed findings in this study were “pouch outlet stricture” and “mesentery twist”. Overall analysis trended toward reduction in frequency of clinically significant missed findings, but was not statistically significant. Pouch outlet stricture is difficult to diagnose on these pelvic MRI studies in particular, as no anal contrast is utilized for these studies. In our experience, there remains a discrepancy of detecting pouch outlet stricture on MRI when compared to EUA, which highlights the complimentary role of Water Soluble Contrast Enema (WSCE). Compared with MRI, WSCE has the advantage of diagnosing strictures given its dynamic real-time imaging, which can show contrast material flow impedance and fixed narrowing and large volume retained contrast on post evacuation imaging to help diagnose an outlet stricture. Therefore, for institutions that do not routinely perform same day GGE in addition to MRI pelvis, there should be consideration to add retrograde contrast administration and post evacuation sequences to help detect an outlet stricture. In addition, the identification of sharp angulation at the pouch inlet on imaging may not always correlate with true afferent loop syndrome, given that the positioning of the patient during a pelvic MRI is not reflective of how a patient would evacuate in the real-world setting and that our current MRI pouch protocol does not include dynamic imaging nor rectal contrast, to assess for dynamic changes in anatomy and truly assess for afferent loop syndrome. We also notice at our institution that there is persistent discordance of “mesentery twist” between imaging interpretation and EUS/surgical report, regardless of reader experience, which may be a result of surgical techniques varying not only based on surgeon preference, but also on a case-to-case basis, leading to different positioning and appearance of the mesentery. These findings highlight areas that may benefit from future research to improve our understanding; however, following discussion of this with the colorectal surgeons at our institution, it was determined that these imaging findings would be useful information to include in the reports as suspected findings for them to be aware of preoperatively, even if not considered a truly diagnostic part of the examination.

Using a structured template alleviates the need to recall every key feature to be included in a report, especially when interpreting studies that are relatively infrequently encountered, such as ileal pouch assessment, and helps prevent potential missed diagnoses. An additional benefit of structured reporting is facilitating learning among trainees and inexperienced radiologists. Using the structured template provides a standardized and systematic approach to assessing key features of a study and ensuring the proper information is included in a report. Previously, the implementation of checklists for radiologists has been suggested as a method to reduce variability and decrease error rates [20, 21], and this method of reporting provides a format for progressing through a checklist. Inclusion of all needed anatomy and pertinent negatives in the structured report offers an ordered framework for trainees to adopt. This is especially important when interpreting complex cases with little prior experience. Furthermore, the inclusion of pertinent negative findings is considered an important part of any radiology report, and is especially important in the case of preoperative planning [22].

Given that the structured report template arose from a collaboration between the radiologists and the colorectal surgeons, the absence of key reporting elements prior to structured report implementation was likely due to a lack of ongoing education and collaboration with the surgeons. In addition, the adoption of structured reporting is not always immediately embraced by all radiologists in a department. As shown in our study, affiliate site readers had the smallest increase in the number of key features described after adoption of the structured reporting template, often deleting some of the fields in the structured reporting templates or even using free-dictated reports without use of the template or codified nomenclature. One factor may be unfamiliarity with some unique aspects of ileal pouch anatomy and the template itself. While the template was made widely available to all sites, referring physician feedback and continued pouch education, in the form of our own intra-departmental conferences, were not available to the affiliate site radiologists, hence the continued unfamiliarity with some of the terminology related to pouch imaging and decision to delete some of the fields in structured template. Structured reporting templates have been shown to be more time consuming than narrative reports for those unfamiliar with the structured template [23]. This provides a potential area for continued education on pouch assessment within the radiology department.

One significant limitation of this study is that the standardized reporting template was developed at a single institution, through the consensus of preferences from a multidisciplinary team involving institutional radiologists and IBD surgeons. Although, individual radiology and surgery department preferences may vary by institution, we believe this structured reporting template provides a useful foundation for further modification at other institutions. At our institution, this template also has the potential to evolve and

adapt based on continued feedback from our radiology and surgery departmental colleagues. Additionally, many of the patients included in this study are tertiary referral cases, often resulting in incomplete information in our institution's electronic medical record system. This limits our ability to compare imaging findings with direct exam under anesthesia (EUA), pouchoscopy findings, or symptoms of pouch dysfunction. For example, it has been our anecdotal experience that small anastomotic leaks identified on MRI are sometimes not visualized on EUA/pouchoscopy, which may represent an area where MRI provides an important complimentary role to EUA/pouchoscopy and allows detection of findings that may be difficult to directly visualize. However, this lack of a reference standard in this case limits our ability to study the diagnostic performance of MRI pelvis for pouch imaging and consequently, our ability to directly measure the clinical impact of structured versus non-structured MRI pelvis for ileal pouch reporting.

In conclusion, structured reporting of pelvic MRI guides a systematic search pattern and comprehensive evaluation of ileal pouches, and therefore facilitates surgical planning and clinical management. Our standardized reporting template can serve as baseline at other institutions for adaptation based on specific radiology and surgery preferences, fostering a collaborative environment between radiology and surgery, and ultimately improving patient care.

Declarations

Conflict of interest Author AM is a consultant for Bracco Inc. None of the other authors have any disclosures to report.

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