

Predicting the Need for Imaging in IBD: Radiating Only Badness?

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Multiple imaging tests are needed to diagnose, evaluate symptoms of, and manage Crohn's disease (CD) patients, with particular regard to excluding complications such as obstruction, perforation, and abscess [1]. Imaging modalities used in evaluating CD include conventional radiography, fluoroscopy, computed tomography (CT), ultrasound (US), and magnetic resonance imaging (MRI) [1]. CT use has increased extensively in general but especially for those with CD, raising concerns about the effects of radiation exposure and subsequent risk of cancer [2]. The estimated lifetime attributable risk of malignancy from a single abdominal-pelvic CT scan is ~0.7 % [3]. The radiation exposure from a single CT scan can vary greatly based on scanner type, protocol settings, and patient size, with newer protocols that reduce radiation exposure increasingly utilized [4, 5]. CT, especially CT enterography (CTE), is considered the "gold-standard" imaging examination for patients with symptomatic CD. CT provides critical information to treating physicians regarding the presence or absence of disease, disease activity, severity of disease, and complications of penetrating disease such as abscess. Supporting this, a recent study reported that CT performed in the emergency department (ED) changed the management of 81 % of patients with CD with urgent findings in 48 % (35 % penetrating or obstructive disease, 13 % non-IBD urgent findings) [6]. One-third of the patients in this study had a cumulative effective dose (CED)

of >75 millisieverts (mSv). Thus, CT remains a "double-edged sword" given its associated radiation exposure, particularly for younger patients. Multiple retrospective studies have reported radiation exposures in CD patients to be higher than that of the general population [7, 8]. The use of CT in patients with inflammatory bowel disease (IBD) has increased noticeably in the last decade with an 840 % increase from 2003 to 2007 reported at one institution [9]. A retrospective cohort study of 415 patients over 20 years found that usage of CTs increased by 310 % and that 1 in 13 patients was exposed to potentially harmful levels of ionizing radiation defined as CED >50 mSv. A history of IBD-related surgery was a risk factor for high exposure [10]. CD patients are commonly diagnosed in their 20s and 30s with ~20 % diagnosed during childhood [11]. Furthermore, there is an increased risk of radiation-induced malignancies in patients exposed at a younger age given the elevated biologic activity of their tissues and the longer available "lag-time" for the development of malignancy [12]. A recent study by Brenner and Hall [13] suggests that it is not until patients reach 35 years of age that the risks of ionizing radiation decrease substantially.

Since many of the CT scans in CD patients are performed acutely in the ED, it is important to evaluate whether there are predictors of positive or negative factors that would maximize benefit and minimize risk of imaging in this setting. Previous studies of CT use in IBD have identified several risk factors associated with higher radiation exposure. Levi et al. [14] from a single IBD center in Israel reviewed 199 CD and 125 UC patients and reported on the basis of multivariate analysis that IBD-related surgery, CD, prednisone use, first year of diagnosis, and age in the upper quartile were independent predictors. Butcher et al. [15] from a single-center retrospective review of 280 consecutive IBD patients reported that CD,

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smoking status, disease duration, and previous surgery were significant predictors. A retrospective experience on 325 IBD patients from a clinic in Santiago, Chile, reported that CD, longer duration of disease, ileal involvement, stricturing behavior, steroid or biologic agents, and CD-related hospitalizations and surgery were risk factors. A full 19.5 % of their CD patients were exposed to high levels of radiation, defined as CED >50 mSv [16]. In contrast, a smaller retrospective study of 99 CD patients indicated that initiation of an anti-TNF agent decreased radiation exposure in the subsequent year from a CED from 28.1 to 15.0 mSv, unlike steroid treatment, which did not reduce radiation exposure in the subsequent year [17]. A meta-analysis of five studies involving 2,627 participants who provided data for risk factors indicated that IBD-related surgery and steroid use were predictors, with pooled adjusted odds ratio of 5.4 (95 % CI 2.6–11.2) and 2.4 (95 % CI 1.7–3.4), respectively [18]. A retrospective study of 648 adult CD patients presenting in two EDs in the USA found that the use of CT increased from 47 % in 2001 to 78 % in 2009 ($p = 0.005$) while the portion of urgent findings including perforation, obstruction, or abscess remained unchanged in that time period (30, 29 %) [19]. Interestingly, this rate of findings is similar to that reported in the present study from Korea. A previous multicenter study from Korea from the same authors including 13 university hospitals involving 777 CD and 1,422 UC patients from 1987 to 2012 found that 34.7 % of CD and 8.4 % of UC patients had high radiation exposure (CED >50 mSv) [20]. Risk factors identified included longer duration of disease, UGI involvement, surgery, hospitalization, and oral steroids [20]. Thus, it appears that CD, IBD-related surgery, hospitalization, steroids, and complicated disease behavior are common risk factors for radiation exposure across most studies.

In this issue of *Digestive Diseases and Sciences*, Jung et al. [21] report a retrospective study in which the authors analyze urgent findings (i.e., denoting conditions usually requiring inpatient care) initialized as obstruction, perforation, abscess, or non-CD-related urgent findings (OPAN) in CT scans obtained in CD patients visiting the ED. Of the 266 CTs performed, 103 (38.7 %) exhibited urgent findings. A history of structuring or penetrating disease, tachycardia, leukocytosis, and high C-reactive protein (C-RP) predicted urgent CT findings, whereas biologic agent use was identified as a negative predictor. These factors can easily be assessed in the emergency room, prior to obtaining a CT, and be used to risk-stratify the need for imaging, helping minimize unnecessary CT scans, thus avoiding unnecessary radiation exposure, time, and expense.

Limitations of the study include its retrospective design across 10 years, involving 11 separate emergency rooms, and the training and approach of ED physicians in Korea

compared with elsewhere potentially affecting the generalizability of the findings. Although some risk factors overlap with previous studies, not all do and hence prospective studies are needed to clarify which factors are the most important. The risk factors identified in the present study can be quickly and easily assessed in the ER before ordering a CT. Unfortunately, since in many EDs, a CT scan inevitably precedes evaluation by an experienced clinician, it may be difficult to put these data into practice.

Ideally, the criteria identified in this study combined with commonsense practice should inform the patient's gastroenterologist in conjunction with the ER physician regarding the joint decision to scan and examine whether the yield increases, the number of unnecessary CTs decreases, or there are complications from missed findings or from not obtaining imaging. Data should also be obtained regarding the feasibility in the emergency room setting of non-radiation imaging such as MR enterography in younger patients (<35). A recent study using a Markov model examined the cost-versus-benefit of using MRE over CTE in patients under the age of 50 and found it cost effective per year of life saved, and even more so if the age was under 30 [22].

As clinicians, we must use the data in the present study and previous studies to help us target appropriate patients for imaging, thus "radiating only badness." In cases where imaging is needed, particularly in younger patients, we should opt for MRI over CT if possible. Even if CT is required, protocols with the lowest radiation dose possible should be employed. With more coordinated health systems both in the USA and worldwide, patients and caregivers can jointly keep track of cumulative radiation exposure and minimize patients exposed to high levels. Mandating this as a quality measure might help to achieve this goal.

References

1. Grand DJ, Harris A, Loftus EV. Imaging for luminal disease and complications: CT enterography, MR enterography, small-bowel follow-through, and ultrasound. *Gastroenterol Clin N Am*. 2012;41:497–512.
2. Jaffe TA, Gaca AM, Delaney S, et al. Radiation doses from small-bowel follow-through and abdominopelvic MDCT in Crohn's disease. *Am J Roentgenol*. 2007;189:1015–1022.
3. Sodickson A, Baeyens PF, Andriole KP, et al. Recurrent CT, cumulative radiation exposure and associated radiation-induced cancer risks from CT of adults. *Radiology*. 2009;251:175–184.
4. Sagara Y, Hara AK, Pavlicek W, et al. Abdominal CT: comparison of low-dose CT with adaptive statistical iterative reconstruction and routine-dose CT with filtered back projection in 53 patients. *Am J Roentgenol*. 2010;195:713–719.
5. Kambadakone AR, Chaudhary NA, Desai GS, et al. Low-dose MDCT and CT enterography of patients with Crohn disease: feasibility of adaptive statistical iterative reconstruction. *Am J Roentgenol*. 2011;196:W743–W752.
6. Israeli E, Ying S, Henderson B, et al. The impact of abdominal computed tomography in a tertiary referral centre emergency

- department on the management of patients with inflammatory bowel disease. *Aliment Pharmacol Ther.* 2013;38:513–521. doi:[10.1111/apt.12410](https://doi.org/10.1111/apt.12410).
7. Huang JS, Tobin A, Harvey L, et al. Diagnostic medical radiation in pediatric patients with inflammatory bowel disease. *J Pediatr Gastroenterol Nutr.* 2001;53:502–506.
 8. Sauer CG, Kugathasan S, Martin DR, et al. Medical radiation exposure in children with inflammatory bowel disease estimates high cumulative doses. *Inflamm Bowel Dis.* 2011;17:2326–2332.
 9. Pelloquin JM, Pardi DS, Sandborn WJ, et al. Diagnostic ionizing radiation exposure in a population-based cohort of patients with inflammatory bowel disease. *Am J Gastroenterol.* 2008;103:2015–2022.
 10. Chatu A, Poulis A, Holmes R, et al. Temporal trends in imaging and associated radiation exposure in inflammatory bowel. *Int J Clin Pract.* 2013;67:1057–1065. doi:[10.1111/ijcp.12187](https://doi.org/10.1111/ijcp.12187).
 11. Kroeker KI, Lam S, Birchall I, et al. Patients with IBD are exposed to high levels of ionizing radiation through CT scan diagnostic imaging: a five year study. *J Clin Gastroenterol.* 2011;45:34–39.
 12. Fucic A, Brunborg G, Lasan R, et al. Genomic damage in children accidentally exposed to ionizing radiation: a review of the literature. *Mutat Res.* 2008;658:111–123.
 13. Brenner DJ, Hall EJ. Computed tomography—an increasing source of radiation exposure. *N Engl J Med.* 2007;357:2277–2284.
 14. Levi Z, Fraser E, Krongrad R, et al. Factors associated with radiation exposure in patients with inflammatory bowel disease. *Aliment Pharmacol Ther.* 2009;30:1128–1136.
 15. Butcher RO, Nixon E, Sapundzleski M, et al. Radiation exposure in patients with inflammatory bowel disease—primum non nocere? *Scand J Gastroenterol.* 2012;47:1192–1199.
 16. Estay C, Simian D, Lubascher J, et al. Ionizing radiation exposure in patients with inflammatory bowel disease: are we overexposing our patients? *J Dig Dis.* 2014. doi:[10.1111/1751-2980.12213](https://doi.org/10.1111/1751-2980.12213).
 17. Patil SA, Rustgi A, Quezada SM, et al. Anti-TNF therapy is associated with decreased imaging and radiation exposure in patients with Crohn's disease. *Inflamm Bowel Dis.* 2013;19:92–98. doi:[10.1002/ibd.22982](https://doi.org/10.1002/ibd.22982).
 18. Chatu S, Subramanian V, Pollock RC. Meta-analysis: diagnostic medical radiation exposure in inflammatory bowel disease. *Aliment Pharmacol Ther.* 2012;35:529–539.
 19. Kerner C, Carey K, Mills AM, et al. Use of abdominopelvic computed tomography in emergency departments and rates of urgent diagnosis in Crohn's disease. *Clin Gastroenterol Hepatol.* 2012;10:52–57.
 20. Jung YS, Park DI, Kim YH, et al. Quantifying exposure to diagnostic radiation and factors associated with exposure to high levels of radiation in Korean patients with inflammatory bowel disease. *Inflamm Bowel Dis.* 2013;19:1852–1857.
 21. Jung YS, Park DI, Hong SN, et al. Predictors of urgent findings on abdominopelvic CT in patients with Crohn's disease presenting to the emergency department. *Dig Dis Sci.* (Epub ahead of print). doi:[10.1007/s10620-014-3298-9](https://doi.org/10.1007/s10620-014-3298-9).
 22. Cipriano LE, Levesque BG, Zaric GS, et al. Cost-effectiveness of imaging strategies to reduce radiation-induced cancer risk in Crohn's disease. *Inflamm Bowel Dis.* 2012;18:1240–1248. doi:[10.1002/ibd.21862](https://doi.org/10.1002/ibd.21862).