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Case Report

Young-onset colon adenocarcinoma masquerading as acute appendicitis ☆,☆☆

Bridget N Kowalczyk, MD^{a,*}, John Paek, DO^b, Vivek Bansal, MD, PhD^{c,d}

^aDepartment of Internal Medicine, University of Houston College of Medicine / HCA Houston Healthcare West, Houston, TX, USA

^bNorth Texas Surgical Specialists, Kingwood, TX, USA

^cRadiology Partners Gulf Coast, Houston, TX, USA

^dDepartment of Biomedical Science, University of Houston College of Medicine, Houston, TX, USA

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ABSTRACT

This case report presents the findings of colon adenocarcinoma in a young adult male who presented with vague abdominal pain as his only complaint, suspicious of appendicitis. The patient underwent abdominal computed tomography (CT) imaging for further evaluation of his abdominal pain. CT findings showed pericecal fat stranding and prominent lymph nodes concerning for acute appendicitis, but the appendix could not be adequately visualized; due to the indeterminate CT findings, general surgery proceeded to perform an exploratory laparotomy on the patient and removed an appendiceal mass-like structure that was revealed to be invasive adenocarcinoma of the colon per pathology. This case report details the radiological and pathological findings of colorectal adenocarcinoma presenting similarly to acute appendicitis and demonstrates that colorectal adenocarcinoma must be considered on the list of differentials in young adults presenting with abdominal pain and unclear CT imaging.

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Introduction

Colon cancer is the third most diagnosed cancer in both men and women and the second leading cause of cancer

deaths in the United States [1]. Colon adenocarcinoma typically presents in older patients (age >60) with common symptoms including changes in bowel habits, bloody stools, abdominal pain, unintentional weight loss, and fatigue [2]. However, these symptoms can be nonspecific and may not appear until

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* Corresponding author.

E-mail address: bridget.kowalczyk@hcahealthcare.com (B.N. Kowalczyk).

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the cancer is advanced, making early detection of colon cancer difficult. The American Cancer Society recently reported that the overall mortality rate of colorectal cancer has declined in the past decade, but the report also raised alarms about the drastic shift in trends of the disease; increasingly, more cases of colorectal cancer (CRC) are diagnosed in individuals less than 55 years of age. Alarming, more and more patients under the age of 55 are found to have advanced stages of the disease [1]. Consequently, guidelines have adjusted to reflect the need to screen more individuals at a younger age. The United States Preventative Task Force (USPTF) recently lowered their colorectal screening recommendation from 50 to 45 years of age for adults with average risk of developing CRC [3]. Amidst a growing realization that CRC is affecting younger patients, diagnosis of CRC remains challenging in patients younger than 40 years of age as the disease is a skilled imitator of alternative etiologies of abdominal pain such as genitourinary infections, genitourinary emergencies, bowel obstruction, and appendicitis. The goal of this case report is to describe the radiological and pathological findings of CRC masquerading as acute appendicitis, highlighting the need to consider malignancy in young adults with abdominal pain and ambiguous CT imaging.

Case presentation

A 28-year-old male with no significant past medical history presented to the emergency room for worsening right lower quadrant abdominal pain for 1 day. The patient described the pain as pressure-like, nonradiating, constant, and progressively worsening overnight. At the time of presentation, he rated his pain as a 5/10. Additionally, he denied experiencing similar symptoms in the past. He denied associated nausea, vomiting, fever, changes in bowel habits, decreased appetite, recent weight loss, or changes in his diet or medications. He reported no recent illnesses, trauma, or past abdominal surgeries. He also denied personal and family history of GI disorders or colon cancer.

On arrival to the ED, the patient was afebrile, normotensive, and hemodynamically stable. Physical examination of the patient was notable for tenderness on palpation of the right lower quadrant with no associated rebound or guarding. Labs revealed leukocytosis. A CT abdomen and pelvis with contrast was performed; the radiologist noted pericecal fat stranding and prominent right lower quadrant lymph nodes that were concerning for acute appendicitis (Figs. 1A and B and 2A and B), though the appendix was not visualized. At this time, general surgery was consulted for an emergency appendectomy. The on-call surgeon carefully reviewed the CT scan with the in-house radiologist as the appendix was unable to be identified on imaging and after further discussion, it was decided that given the inflammation surrounding the cecal region, acute appendicitis could not be ruled out. The general surgeon proceeded with emergent laparoscopic appendectomy with possible open conversion. The patient was taken back to the operating room the same day. Intraoperatively, the surgeon visualized an appendiceal mass-like structure adhered to the terminal ileum which was not able to be separated due

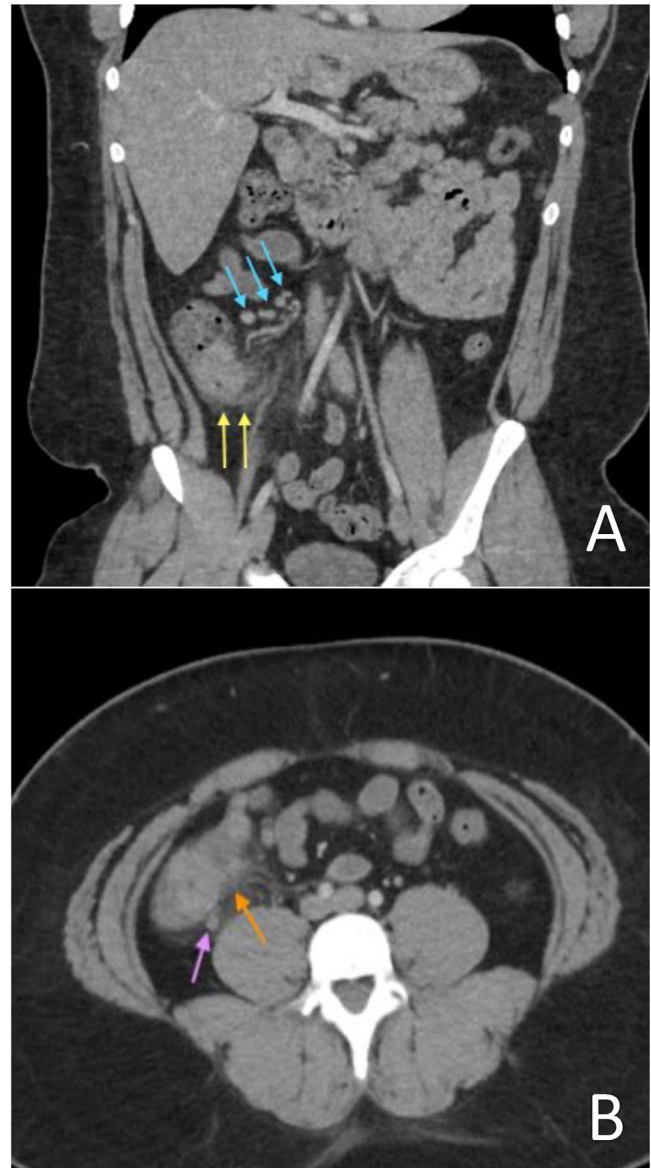


Fig. 1 – CT abdomen and pelvis with IV contrast on admission, (A) coronal (B) axial showing perienteric inflammation and surrounding pericecal fat stranding (yellow and orange arrows) with prominent right lower quadrant lymph nodes (blue and pink arrows). These findings are consistent with acute appendicitis, but the appendix was not visualized on imaging of this patient in any view.

to concern for injury to surrounding structures (Fig. 4). The appendix was noted to be very large and hard to palpation and so, the decision was made to convert to an open ileocecectomy. Once the abdominal cavity was opened, the terminal ileum was freed from the appendiceal mass-like structure, with the specimen left intact and sent to pathology for further inspection and testing (Fig. 3). Successful end-to-end anastomosis of the terminal ileum and right colon was achieved, and the patient tolerated the procedure well without any complications.

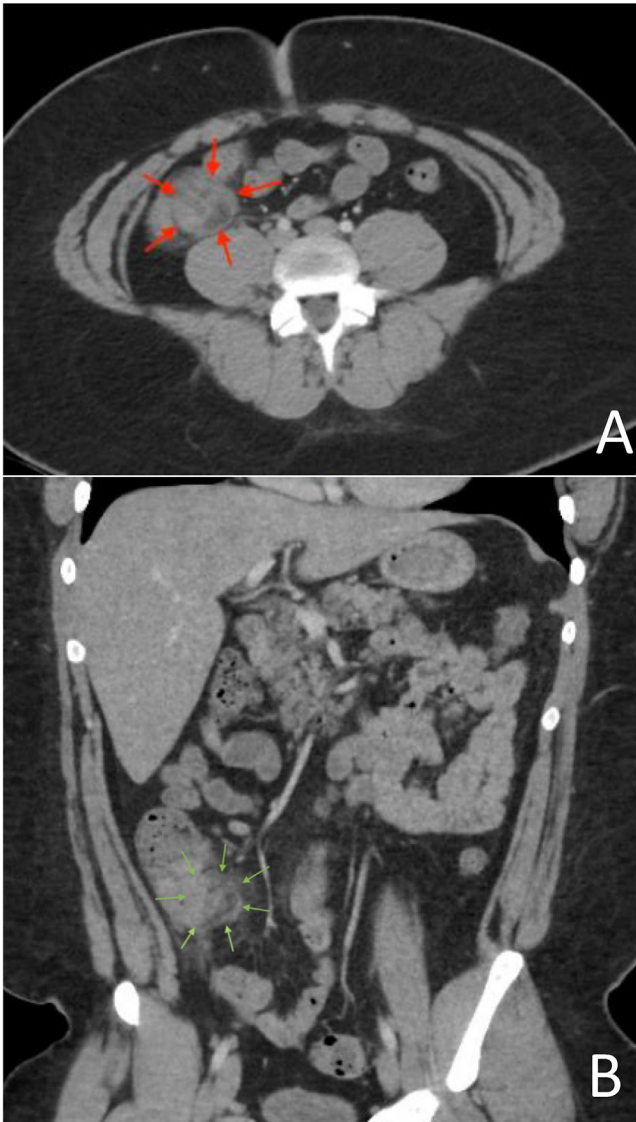


Fig. 2 – CT abdomen and pelvis with IV contrast on admission (A) axial, (B) coronal; A mass-like structure (red and green arrows) in the area of the cecum with surrounding bowel matting that correlates with the gross pathology specimen of the tumor seen in **Figure 3** below. Again, the appendix was not visualized on imaging in this view.

Four days after the appendiceal specimen was removed, the pathology report revealed findings consistent with invasive, moderately differentiated adenocarcinoma of the colon. The tumor measured $5.5 \times 3.5 \times 3$ cm and was located at the appendiceal orifice just beneath the ileocecal valve and extended into the proximal half of the appendix, arising from a tubulovillous adenoma. The tumor invaded through the muscularis propria into the subserosal fat but did not extend to the serosal surface. There was no lymphovascular or perineural invasion of the tumor. Additionally, the specimen was negative for malignancy to 5 regional lymph nodes.



Fig. 3 – Gross pathology of appendiceal specimen; $5.5 \times 3.5 \times 3$ cm tumor was located at the appendiceal orifice just beneath the ileocecal valve and extended into the proximal half of the appendix, arising from a tubulovillous adenoma. Pathology results of the lesion demonstrated moderately differentiated colon adenocarcinoma.

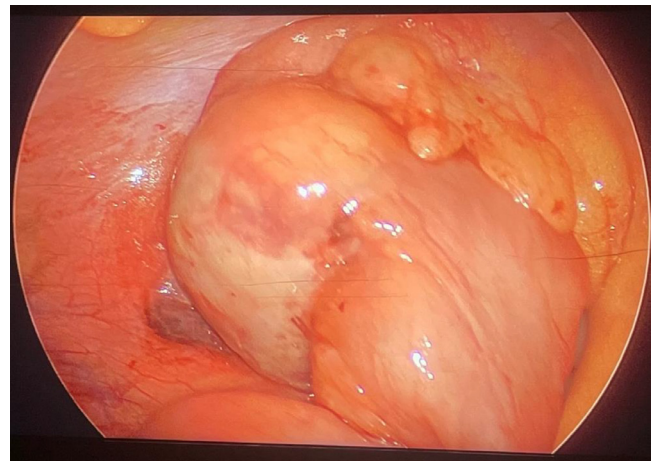


Fig. 4 – Intraoperative photo demonstrating appendiceal mass-like structure with adherence to the terminal ileum. The structure was noted to be hard on palpation.

Discussion

Appendicitis is one of the most common surgical emergencies, mostly occurring in the second and third decades of life. Symptoms typically include migratory periumbilical pain to the right lower quadrant, often associated with nausea, vomiting, fever, and anorexia [4–6]. The pathophysiology results from the inflammation of the finger-like pouch located at the

ileocecal junction, usually by a fecalith or lymphoid hyperplasia [5,6]. While clinical symptoms alone can make the diagnosis, abdominal imaging is routinely used to confirm suspected appendicitis. According to the American College of Radiology, CT imaging is generally the most appropriate and accurate study for evaluating suspected appendicitis and other causes of right lower quadrant abdominal pain, while ultrasound is preferred for pregnant woman and children due to lower radiation [7]. Diagnostic criteria for appendicitis on CT include enlarged appendiceal diameter ≥ 6 mm, appendiceal wall thickening ≥ 3 mm, hyperemic appendiceal wall, and peri-appendiceal fat stranding [14]. Evidence of appendicolith, peri-appendiceal fluid collection, and right lower quadrant lymphadenopathy may also be visualized on CT imaging [14]. Although highly specific and sensitive, most CT studies evaluating for appendicitis are obvious and uncomplicated, but occasionally, the appendix is not visualized or presents with ambiguous features, as seen in this case report [7,8].

It is rare for appendicitis to indicate cecal adenocarcinoma, but a few cases have been reported, almost exclusively in individuals > 55 years of age [9–11]. Retrospective studies show that appendicitis in older adults (>40) carries a higher risk of underlying malignancy [11,15,16]. Therefore, malignancy should be considered in the differential diagnoses for this age group presenting with appendicitis-like symptoms. Although the connection between appendicitis and underlying colorectal malignancy is well established, the literature lacks evidence of a link between them in younger adults. As CRC can mimic appendicitis in younger patients, emergency exploratory surgery is often needed to determine the cause of abdominal pain when CT imaging cannot definitively distinguish between malignancy and appendicitis.

Colon adenocarcinoma is a common histopathological type of CRC, ranking fourth in men and third in women in the US. Associated risk factors include a high-fat, low-fiber diet, physical inactivity, obesity, smoking, and family history of gastrointestinal diseases and cancers [2]. The incidence increases with age, a major unchangeable risk factor for the development of CRC. Despite an overall decrease in new CRC-associated mortality thanks to widespread screening, cases in adults under 40 are rising alarmingly, with unclear causes [2,12]. Colonoscopy is the gold standard screening for CRC. Guidelines recommend starting at age 45 for average-risk individuals, with repeat colonoscopy every 10 years [3]. In individuals with family history of gastrointestinal disorders, screening should begin at age 40 or 10 years prior to the age of diagnosis of the relative, whichever comes first [3]. CT imaging is not recommended for initial detection of CRC, but can be utilized in preoperative staging of tumors, identifying local and distant spread of the malignancy, and monitoring disease progression [13]. In recent years, CT colonography has become another valuable, less invasive option for CRC screening, as the acquired images are processed to recreate 2D and 3D images of the colon that the radiologist reads. According to both the USPTF and the American College of Radiology, CT colonography every 5 years is appropriate for CRC screening in average-risk individuals.

Yet, these screening recommendations do not capture the rise in patients under 40 with colorectal cancer, often leaving them undiagnosed until the disease has progressed to ad-

vanced stages. More attention and research directed towards young-onset CRC have been initiated in recent years, with early studies indicating a left-sided predilection for tumor development, lack of family history or disease phenotype, and differences in molecular characteristics than those seen in classic CRC [17,12]. This makes risk-assessment of younger adults even more challenging. Further investigation into the possible causes, risk factors, and role of screening in this younger demographic is desperately needed to adjust treatment paradigms to appropriately ensure optimal outcomes in caring for CRC in this population.

Conclusion

Colon adenocarcinoma may rarely present as acute appendicitis, but the rising incidence of CRC in patients under 40 necessitates its consideration in differential diagnoses for vague right lower quadrant pain. While clinical symptoms of appendicitis are often clear, CT scans are critical for confirmation, although interpretation can be challenging and requires consideration of other causes, including malignancy. Despite existing CRC screening guidelines, the rise in young-onset CRC highlights the need for further research and updated screening protocols. Colonoscopy remains the gold standard, but emerging methods like CT colonography show promise, emphasizing the importance of ongoing investigation into optimal screening strategies for younger populations. Understanding the unique characteristics and risk factors of young-onset CRC is essential for early detection and improved management of this growing concern.

Patient consent

A written informed consent was obtained from the patient for the publication of this case report.

REFERENCES

- [1] Siegel RL, Wagle NS, Cercek A, Smith RA, Jemal A. Colorectal cancer statistics, 2023. *CA Cancer J Clin* 2023;73(3):233–54. doi:10.3322/caac.21772.
- [2] Sawicki T, Ruzkowska M, Danielewicz A, Niedźwiedzka E, Arłukowicz T, Przybyłowicz KE. A review of colorectal cancer in terms of epidemiology, risk factors, development, symptoms and diagnosis. *Cancers (Basel)* 2021;13(9):2025. doi:10.3390/cancers13092025.
- [3] Colorectal cancer: screening. <https://www.uspreventiveservicestaskforce.org/uspstf/recommendation/colorectal-cancer-screening#fullrecommendationstart>. Published May 18, 2021.
- [4] Wickramasinghe DP, Xavier C, Samarasekera DN. The worldwide epidemiology of acute appendicitis: an analysis of the global health data exchange dataset. *World J Surg* 2021;45(7):1999–2008. doi:10.1007/s00268-021-06077-5.
- [5] Bhangu A, Søreide K, Di Saverio S, Assarsson JH, Drake FT. Acute appendicitis: modern understanding of pathogenesis,

- diagnosis, and management. *Lancet* 2015;386(10000):1278–87. doi:[10.1016/S0140-6736\(15\)00275-5](https://doi.org/10.1016/S0140-6736(15)00275-5).
- [6] Ryan WL. *Appendicitis : symptoms, diagnosis, and treatments*. 1st ed. Hauppauge: Nova Science Publishers, Incorporated; 2011.
- [7] Camacho MA, Karolyi DR, Kim DH, Cash BD, Chang KJ, et al., Expert Panel on Gastrointestinal Imaging ACR Appropriateness Criteria® Right Lower Quadrant Pain-Suspected Appendicitis. *J Am Coll Radiol* 2018;15(11S):S373–87. doi:[10.1016/j.jacr.2018.09.033](https://doi.org/10.1016/j.jacr.2018.09.033).
- [8] Hunsaker JC, Aquino R, Wright B, Kobes P, Kennedy A, Dunn D. Review of appendicitis: routine, complicated, and mimics. *Emerg Radiol* 2023;30(1):107–17. doi:[10.1007/s10140-022-02098-2](https://doi.org/10.1007/s10140-022-02098-2).
- [9] Shroff N, Bhargava P. Metastatic Cecal Adenocarcinoma presenting as acute appendicitis. *Radiol Case Rep* 2021;16(8):2129–32. doi:[10.1016/j.radcr.2021.04.077](https://doi.org/10.1016/j.radcr.2021.04.077).
- [10] Mejia J, Haj R, Nithisoontorn S, Louis MA, Mandava N. A wolf in sheep's clothing: concomitant appendicitis with occult cecal adenocarcinoma. *Int Surg J* 2021;8(7):2154. doi:[10.18203/2349-2902.isj20212724](https://doi.org/10.18203/2349-2902.isj20212724).
- [11] Sieren LM, Collins J, Weireter LJ, et al. The incidence of benign and malignant neoplasia presenting as acute appendicitis. *Am Surg* 2010;76(8):808–11. doi:[10.1177/000313481007600822](https://doi.org/10.1177/000313481007600822).
- [12] Weinberg BA, Marshall JL. Colon cancer in young adults: trends and their implications. *Curr Oncol Rep* 2019;21(1):3. Published 2019 Jan 18. doi:[10.1007/s11912-019-0756-8](https://doi.org/10.1007/s11912-019-0756-8).
- [13] Horton KM, Abrams RA, Fishman EK. Spiral CT of colon cancer: imaging features and role in management. *Radiographics* 2000;20(2):419–30. doi:[10.1148/radiographics.20.2.g00mc14419](https://doi.org/10.1148/radiographics.20.2.g00mc14419).
- [14] Monsonis B, Mandoul C, Millet I, Taourel P. Imaging of appendicitis: tips and tricks. *Eur J Radiol* 2020;130:109165. doi:[10.1016/j.ejrad.2020.109165](https://doi.org/10.1016/j.ejrad.2020.109165).
- [15] Shine RJ, Zarifeh A, Frampton C, Rossaak J. Appendicitis presenting as the first manifestation of colorectal carcinoma: a 13-year retrospective study. *N Z Med J* 2017;130(1459):25–32. Published 2017 Jul 21.
- [16] Lai HW, Loong CC, Tai LC, Wu CW, Lui WY. Incidence and odds ratio of appendicitis as first manifestation of colon cancer: a retrospective analysis of 1873 patients. *J Gastroenterol Hepatol* 2006;21(11):1693–6. doi:[10.1111/j.1440-1746.2006.04426.x](https://doi.org/10.1111/j.1440-1746.2006.04426.x).
- [17] Stoffel EM, Murphy CC. Epidemiology and mechanisms of the increasing incidence of colon and rectal cancers in young adults. *Gastroenterology* 2020;158(2):341–53. doi:[10.1053/j.gastro.2019.07.055](https://doi.org/10.1053/j.gastro.2019.07.055).