

Hepatic Abscess in Inflammatory Bowel Disease: A Systematic Scoping Review of an Overlooked Entity

Shadi Abdullah Alshammary, Dhuha Nahar Boumarah

Department of Surgery, College of Medicine, King Fahd Hospital of the University, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia

Abstract

Background: Liver abscess is one of the hepatobiliary manifestations of inflammatory bowel disease (IBD) that has been scarcely described in the literature.

Objectives: To conduct a scoping review to provide a detailed description of the occurrence of hepatic abscess in patients with IBD and summarize the observed clinical features.

Methodology: Searches were carried out using relevant keywords in Medline (via PubMed) and Web of Science from inception until June 13, 2022. Only articles that reported the occurrence of hepatic abscess in patients with IBD were included.

Results: Forty-eight publications (40 case reports and 8 case series) were included, representing 73 patients with IBD who were radiologically or intraoperatively diagnosed with hepatic abscess. Patients with Crohn's disease were more predisposed to developing hepatic abscess than patients with ulcerative colitis (79.5% vs. 20.5%, respectively). Furthermore, pyogenic liver abscess was found to be more prevalent (57.9%) compared with aseptic (38.7%) and amebic (3.2%) abscesses. No clear relation was found between death or prolonged hospital stay in terms of the clinical presentation or management plan, as mortality was reported in different age groups with different managements.

Conclusion: To date, there is no consensus regarding the appropriate management of hepatic abscess as an extraintestinal manifestation of IBD. However, the condition shares several features with liver abscess diagnosed among the general population.

Keywords: Abdominal abscess, amebic liver abscess, aseptic abscess, Crohn's disease, hepatic abscess, hepatobiliary manifestations, inflammatory bowel disease, pyogenic liver abscess, ulcerative colitis

Address for correspondence: Dr. Shadi Abdullah Alshammary, Department of Surgery, College of Medicine, King Fahd Hospital of the University, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

E-mail: saalshammary@iau.edu.sa

Submitted: 30-Oct-2022 **Revised:** 24-Feb-2023 **Accepted:** 05-Jul-2023 **Published:** 06-Oct-2023

INTRODUCTION

Inflammatory bowel disease (IBD) mainly encompasses two distinct entities, Crohn's disease (CD) and ulcerative colitis (UC), with the former characterized by a fistulizing, abscess-forming nature.^[1,2] The prevalence of IBD is estimated at approximately 84.3 per 100,000 individuals.^[3]

The incidence of IBD has rapidly progressed in the past decades, resulting in a proportional increase in the associated disease burden. The mortality rate of CD can reach up to 1.6%, while patients with UC have a cumulative survival rate relatively similar to that of the general population.^[4,5] Both CD and UC have a chronic, relapsing–remitting,

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com

How to cite this article: Alshammary SA, Boumarah DN. Hepatic abscess in inflammatory bowel disease: A systematic scoping review of an overlooked entity. Saudi J Med Med Sci 2023;11:267-74.

Access this article online

Quick Response Code:



Website:

<https://journals.lww.com/sjmm>

DOI:

10.4103/sjmms.sjmms_545_22

inflammatory involvement of the gastrointestinal tract.^[1] Various hypotheses have been proposed to explain the complex etiopathogenesis of IBD. It is theoretically acceptable that among genetically predisposed individuals, environmental factors can trigger a cascade of dysregulated immune responses, with abundant production of proinflammatory cytokines.^[6]

Although IBD primarily involves the intestines, it is recognized as a multisystemic disorder that has several extraintestinal manifestations. Therefore, patients can experience a wide spectrum of symptoms based on the site of involvement. Several epidemiological studies have explored the prevalence of extraintestinal manifestations of IBD. A prospective study was conducted by Mendoza *et al.* to determine the prevalence of extraintestinal involvement in IBD. The authors found that almost half of the recruited participants with IBD (46.6%) exhibited at least one extraintestinal feature.^[7] IBD-associated hepatobiliary disorders present in >30% of the patients, and include primary sclerosing cholangitis (PSC), non-alcoholic fatty liver disease (NAFLD), granulomatous hepatitis, cholelithiasis, primary biliary cirrhosis, and hepatic abscess.^[8] NAFLD is considered the most frequently observed hepatobiliary disease seen in IBD patients, whereas PSC is the most specific.^[9] Liver abscess, defined as a localized accumulation of suppurative material within the hepatic parenchyma, is one of the IBD-associated hepatobiliary conditions that has scarcely been described in the literature.^[10] Based on the pathogenic agent, it can be classified into pyogenic, amebic, and, to a lesser extent, fungal subtypes. It has been postulated that the state of immunosuppression, established among most IBD patients, and alteration of normal gut flora play a pivotal role in liver abscess development.^[11]

This scoping review aims to provide and illustrate evidence regarding the occurrence of hepatic abscess among IBD patients and explore the associated clinical characteristics based on existing literature. To our knowledge, this is the first scoping review to address this association.

MATERIALS AND METHODS

The present scoping review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Review (PRISMA-ScR) guidelines.^[12]

Search strategy

Medline (via PubMed) and Web of Science were systematically searched for eligible publications. An

extensive literature review was performed to include all relevant published articles addressing the occurrence of hepatic abscess in IBD. No time filters were applied, and the last search was carried out on June 13, 2022. Only articles published in English were retrieved. The search terms included a combination of “liver abscess”, “hepatobiliary” and “hepatic abscess” with one of the following keywords: “Crohn’s disease”, “inflammatory bowel disease”, “IBD,” or “ulcerative colitis.” No restrictions were applied regarding the study design or publication period, and we included both adult and pediatric cases. Reference lists of all relevant studies were reviewed for additional articles. Both the authors independently carried out the searches, and all discrepancies were resolved through discussion.

Study selection

All duplicates were removed using EndNote version 20, and the title and abstract of the remaining retrieved articles were screened for relevance. Articles deemed not relevant were excluded, and the full text of the remaining studies were reviewed. Studies were included in this review if they reported the association between IBD and liver abscess, and excluded if they (a) did not report the variables assessed in this review, (b) reported the occurrence of hepatic abscess in patients other than those with IBD, (c) documented the association of IBD with abscess involving sites other than the liver, and (d) the full text was not available. Both the authors independently reviewed the retrieved studies, and all discrepancies were resolved through discussion.

Data extraction and quality assessment

The following variables were extracted from the eligible studies in a pre-prepared form: date and place of publication, demographic characteristics (age and gender), clinical presentation, comorbidities, causative organism identified in culture, IBD duration and activity status, hepatic abscess features, therapeutic intervention, and the outcomes in terms of death versus clinical improvement with or without a prolonged hospital course. The authors independently piloted the extraction form. The reliability and reproducibility of extraction between the authors were also determined during this stage.

A validated tool developed by Murad *et al.* was utilized to assess the methodological quality of the included case reports and case series. Four different aspects were taken into consideration (selection, ascertainment, causality, and reporting). Each study was evaluated by eight questions and the aspects were reported in the following pattern: one question for selection, two questions for ascertainment, four concerned with causality, and one question to assess reporting.^[13]

Data synthesis

Descriptive statistics were used to interpret the findings, mean and standard deviation represented continuous variables while dichotomous variables were interpreted as frequencies and percentages. The data synthesis was done using IBM SPSS statistics for Mac version 26.0 (Armonk, NY, USA). A meta-analysis was not possible due to the heterogeneity of the included case reports and case series.

RESULTS

Literature search

The initial search retrieved 1146 records, and an additional 34 articles were identified through hand search. After the removal of duplicates, the titles and abstracts of 617 articles were screened, of which the full text of 215 studies were assessed for eligibility. Forty-eight publications were then selected for inclusion, with a total of 73 patients who were radiologically or intraoperatively diagnosed with hepatic abscess [Figure 1]. All subjects included in this review were also diagnosed with IBD either prior to or after presenting with hepatic abscess.

Only case reports and case series were included because none of the identified articles with higher levels of evidence met our inclusion criteria. Supplementary Tables 1 and 2 demonstrate detailed characteristics of the included studies. Concerning the assessment of methodological quality, Supplementary Table 3 provides the evaluation of all

included case series and reports based on the above-stated four domains.

Characteristics of the included studies

Out of the 48 selected articles, 8 publications were case series and 40 were case reports. The number of cases reported in each case series was as follows: seven patients ($n = 1$),^[32] six patients ($n = 2$),^[15,19] four cases ($n = 1$),^[17] three cases ($n = 2$),^[21,26] and two cases ($n = 2$).^[14,27] Two of the included case series were reported by André *et al.*, one of which was a report of 30 patients with and without IBD; in this series, only seven patients met our inclusion criteria and only those were included.^[21,32] The first reported case was documented in 1983,^[14] and the latest was published in 2022.^[48] Regarding the geographical distribution of articles, most of the studies were carried out in the United States ($n = 21$), followed by the United Kingdom ($n = 4$),^[16,23,35,37] Spain ($n = 3$),^[30,36,44] and Japan ($n = 3$).^[38,51,60] Only one study was conducted in Saudi Arabia,^[47] and just one article was published from the remaining Arabian Gulf Countries, from Kuwait.^[22] The remaining studies were reported from Italy,^[25,34] Israel,^[27,28] France,^[21,32] Korea,^[55] Portugal,^[53] Germany,^[29] Turkey,^[31] India,^[39] China,^[40] Switzerland,^[45] Canada,^[49] and The Netherlands.^[43]

Epidemiological aspects

CD was reported more frequently than UC (79.5% vs. 20.5%, respectively). A male preponderance was noted, with 50 patients being male (68.5%). With regards to age, the median age of selected cases was 35 years

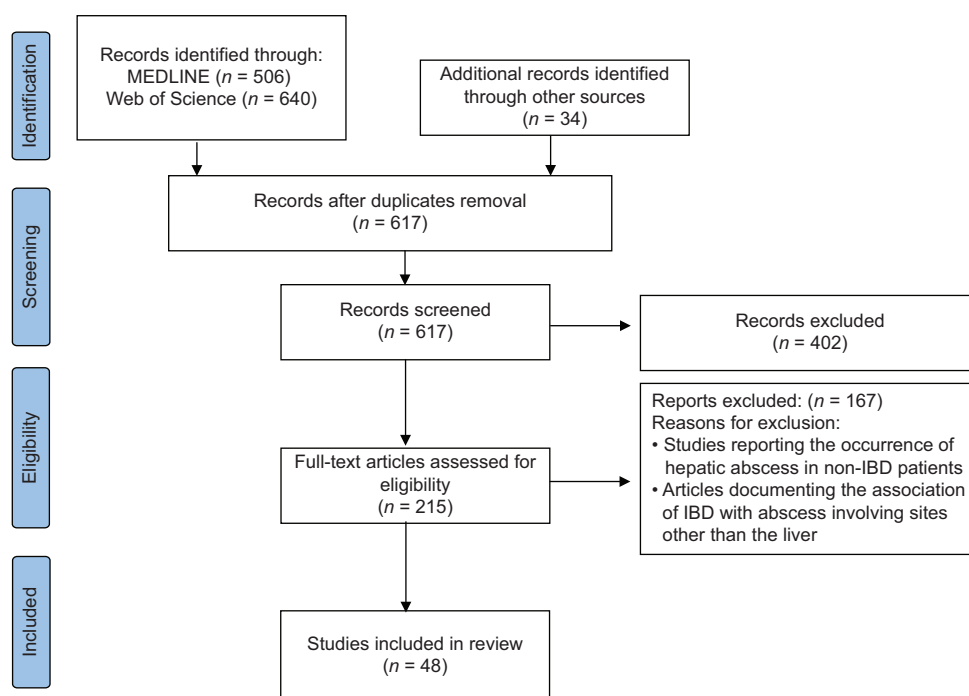


Figure 1: Flow diagram summarizing the literature search process and study selection

(range: 10–87 years). Of the 73 reported patients, 9 were pediatrics (i.e., aged <18 years), and all of these, except one patient, were diagnosed with CD.^[58]

Causative agents

The majority of the patients were diagnosed with pyogenic liver abscess (57.9%), followed by aseptic abscess (38.7%) and amebic abscess (3.2%, $n = 2$). Further, pyogenic liver abscess accounted for the highest percentage in both CD and UC; no amebic abscess cases were found in the UC group [Figure 2]. None of the reviewed cases had a fungal abscess.

Among the pyogenic liver abscess group, *Streptococcus intermedius* was the most common organism ($n = 13$). Other organisms detected in culture were *Escherichia coli* ($n = 5$), *Proteus mirabilis* ($n = 2$), *Staphylococcus albus* ($n = 1$), *Staphylococcus aureus* ($n = 2$) (one of these was resistant to methicillin), *Streptococcus viridans* ($n = 2$), *Pediococcus* species ($n = 1$), *Streptococcus faecalis* ($n = 1$), *Propionibacterium acnes* ($n = 1$), *Morganella morganii* ($n = 1$), *Fusobacterium nucleatum* ($n = 2$), *Enterococcus faecalis* ($n = 1$), *Parvimonas micra* ($n = 1$), unspecified *Peptostreptococcus* species ($n = 3$), unspecified enterococcal species ($n = 1$), unspecified *Streptococci* ($n = 4$), unspecified α -hemolytic *Streptococcus* ($n = 2$), and unspecified Gram-positive cocci ($n = 1$). Culture result was not documented in 15.1% of the cases ($n = 11$). Monomicrobial organisms were isolated in 28 patients, whereas polymicrobial cultures were identified in eight cases.

Predisposing factors

Most of the patients in the included papers (65.8%) had an insignificant past medical history apart from the previous diagnosis of IBD. Reported comorbidities included malnutrition ($n = 6$), rheumatoid arthritis ($n = 1$), hypertension ($n = 2$), systemic amyloidosis ($n = 1$), peptic ulcer disease ($n = 1$), renal failure ($n = 1$), sigmoid cancer ($n = 1$), diverticulosis ($n = 3$), ischemic heart disease ($n = 1$),

chronic obstructive sleep apnea ($n = 1$), hepatitis ($n = 1$), tuberculosis ($n = 1$), PSC ($n = 3$), ankylosing spondylitis ($n = 2$), sacroiliitis ($n = 1$), treated lymphoma ($n = 1$), psoriasis ($n = 1$), and benign prostatic hyperplasia ($n = 1$).

Clinical manifestations

Almost all patients in the selected publications exhibited nonspecific gastrointestinal features, with varying duration. Fever was the most frequently reported symptom, accounting for approximately 86% of the cases. Abdominal pain was reported in 58.9% of the patients. Other documented gastrointestinal signs and symptoms were watery diarrhea (27.4%), bloody diarrhea (4.1%), jaundice (1.4%), increased stoma output (1.4%), anorexia (6.8%), nausea (1.4%), vomiting (5.5%), abdominal distension (4.1%), septic shock (1.4%), constipation (1.4%), and rectal bleeding (1.4%). In a minority of the patients, symptoms were accompanied by respiratory manifestations such as chest pain (1.4%), cough (4.1%), and dyspnea (1.4%). In addition to fever, other constitutional symptoms were as follows: weight loss (26%), night sweats (8.2%), and fatigue (4.1%). Moreover, only one patient experienced back pain (1.4%).

Radiologic characteristics of hepatic lesions

The number of lesions was not reported in 10 publications, while specific lobe involvement was not mentioned in 15 cases. Nearly 67% of the patients had isolated right lobar involvement. In five patients, the left hepatic lobe was the only origin of lesions, while in 14 cases, both lobes were occupied. With regards to the number of identified lesions, hepatic abscess manifested as several and solitary cystic lesions in 40 and 23 cases, respectively.

Therapeutic challenges

Antibiotic administration was not mentioned in 17.8% of the cases; however, it may have been given but not reported explicitly. Percutaneous drainage was utilized in less than half of the patients (47.9%) and aspiration was attempted in three patients (4.1%). On the other hand, surgical drainage was performed in 16 patients (21.9%) and hepatic resection was required to manage 3 patients (4.1%). Corticosteroids and other immunosuppressive agents were administered to 23 patients.

Outcome assessment

Despite observed variation in management approaches, clinical improvement of hepatic abscess was reported by the majority of authors in 58 patients. Improvement with a prolonged hospital course (>30 days) was reported by 9 publications. Death was recorded in 6 papers, with an overall fatality rate of 8.2%.

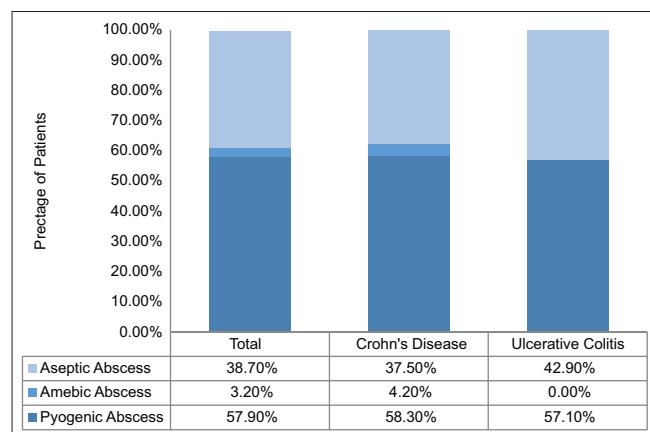


Figure 2: Type of hepatic abscess diagnosed in Crohn's disease and ulcerative colitis

DISCUSSION

In this scoping review, we assessed the epidemiologic features and clinical aspects of hepatic abscess diagnosed in IBD patients. Based on our results, patients with CD were found to be more predisposed to developing hepatic abscess than patients with UC. Considering the increased susceptibility of patients with CD to present with other types of abscesses, it is perhaps not surprising to have a similar tendency for hepatic abscess among affected patients. An epidemiological association was observed by Yamaguchi *et al.* between CD and the development of intra-abdominal abscesses, with a prevalence estimated to reach 25%.^[61] To further portray the ability of CD to induce abscess formation, perianal abscess was reported to occur in 80% of patients with CD.^[62] Although CD had long been recognized to increase the risk of abscess formation, abscess localized to hepatic parenchyma remains a poorly explored entity. Interestingly, a nationwide cohort study from Taiwan that assessed the incidence of only pyogenic liver abscess among patients with IBD found that patients with UC were more likely to develop pyogenic liver abscess than those with CD. This finding is contradictory to that of the current review, although it should be noted that the current review included all categories of hepatic abscess in the assessment.^[63]

The occurrence of hepatic abscess in patients with IBD could be attributed to the proposed increased permeability of the intestinal mucosal wall, which, in part, enhances the spread of altered intestinal flora. Dissemination through portal circulation is another postulated mechanism from which hepatic abscess might primarily originate.^[11] Malnutrition seems to be a contributing factor; however, the exact predisposition has yet to be determined. The majority of patients with IBD experience a prolonged physiologic state of catabolism that can weaken the immunity and reduce their quality of life. A systematic review carried out by Li *et al.*^[64] to assess the effect of malnutrition on the course of IBD concluded that patients' nutritional status can predict the disease clinical outcomes and frequency of flares.

Pyogenic liver abscess represents the most frequent type of hepatic abscess diagnosed among IBD patients, with *S. intermedius* being the most commonly isolated organism. *S. intermedius* is a commensal bacterium that presents on mucosal surfaces of the gastrointestinal lumen, oral cavity, and urogenital tract.^[65] It belongs to the family of *Streptococcus milleri*, also known as the *Streptococcus anginosus* group.^[66] It is intriguing to note that, among individuals of the general population, *E. coli*, on the other hand, is

the most frequent isolated pathogen.^[67] One of the major findings of this study is the identified correlation between IBD and aseptic abscess involving the liver. Aseptic abscess is one of the rare extraintestinal manifestations of IBD, characterized by a sterile neutrophilic infiltration on histopathological examination.^[68]

The complexity in managing cases of aseptic abscess stems from the difficulty of differentiating IBD flares from pure hepatic infections. Nonetheless, negative culture results and the persistence of symptoms after antibiotics administration are two primary indicators of aseptic abscess.^[69] The occurrence of aseptic abscess among patients with IBD is not limited to hepatic parenchyma but can also involve the spleen, pancreas, brain, lungs, and even various lymph nodes.^[32] Although hepatic abscess symptomatology is non-specific, accurate evaluation of clinical manifestation permits early detection and initiation of appropriate management based on the diagnosed type of abscess. In rare instances, hepatic abscess can be the initial presenting feature of IBD that heralds its diagnosis.

A conclusive diagnosis of hepatic abscess in patients with IBD relies on radiologic visualization of the lesions. Ultrasound (US) is frequently the first imaging modality used to establish the diagnosis of liver abscess. Computed tomography (CT) is of great significance for diagnosing hepatic abscess in general due to its ability to provide accurate tissue characterization. Furthermore, CT is considered superior to US, as it can illustrate the presence of fistulization into adjacent organs, along with other potential complications. In this regard, Maconi *et al.* conducted a prospective study to investigate the diagnostic accuracy of US and CT in detecting intra-abdominal complications of CD, including abscess formation, among 625 patients. The authors highlighted the effectiveness of both US and CT in providing an accurate diagnosis of CD-associated abscess, with higher accuracy for CT (91.8%) compared with US (86.9%), due to the probability of false-positive results obtained by US.^[70] The right lobar preference of liver abscess can be simply explained by the rich blood supply delivered through the portal circulation to the right hepatic lobe.

To date, there is no consensus regarding the appropriate management of hepatic abscess as an extraintestinal manifestation of IBD. However, the condition shares several clinical and therapeutic features with liver abscess diagnosed among the general population, with some exceptions concerning aseptic abscess. Empirical administration of antibiotics is essential in all patients to prevent potential septic complications. A simple pharmacotherapy might be

adequate to treat abscess amebic in origin.^[71] For aseptic abscess, however, corticosteroids play a fundamental role in the management and can be given to suspected patients with refractory clinical course and negative cultures.^[72] Drainage is recommended for abscesses measuring >4 cm in size to hasten the recovery of patients and shorten their hospital stay.^[72,73] Consistent with previously published studies addressing the management of hepatic abscess, not specified to IBD, our results revealed that aspiration might be associated with low rates of resolution and high rates of recurrence.^[25] Therefore, image-guided percutaneous drainage remains superior especially for abscesses >10 cm in size.^[74]

To compare the effectiveness of needle aspiration and catheter drainage, a randomized control trial was conducted by a group of Indian radiologists. They highlighted the higher failure rate of needle aspiration and the curative potential of percutaneous catheter drainage.^[75] Current advancements in radiologic interventions have substantially minimized rates of operative drainage and surgical resection. Significantly, there was no clear clinical relation between death or prolonged hospital stay in the cases in relation to the clinical presentation or management plan, as the mortality occurred in different age groups with different management plans. Future guidelines are needed to further elucidate the precise therapeutic approach to achieve optimal outcomes.

The current study has several strengths as it is, to our knowledge, the only scoping review addressing the predisposition of patients with IBD to develop liver abscess. However, the quantity and quality of the included articles may not be adequate to draw a generalizable conclusion. In addition, the heterogeneity of the included studies and restriction to English-language studies are the other limitations of this review.

CONCLUSION

Liver abscess remains a rare, life-threatening extraintestinal complication of CD and UC. The present scoping review provides a detailed description of the occurrence of hepatic abscess in IBD patients and summarizes the observed clinical features. Lack of familiarity and the resultant delay in detection and provision of management contribute significantly to increased rates of morbidity and mortality. Additional studies concerning the diagnosis and management of hepatic abscess in IBD patients, especially the aseptic category, would be helpful to provide accurate diagnostic criteria and precisely define a generalized therapeutic approach.

Peer review

This article was peer-reviewed by two independent and anonymous reviewers.

Data availability statement

Data sharing is not applicable for this article, as no new data were created or analyzed.

Author Contributions

Conceptualization & Design: S.A.; Literature search: S.A. and D.B.; Data acquisition & analysis: S.A. and D.B.; Writing – original draft preparation: S.A. and D.B.; Writing – review and editing: S.A. and D.B.

Both the authors have read and agreed to the published version of the manuscript.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Pariente B, Hu S, Bettenworth D, Speca S, Desreumaux P, Meuwis MA, *et al.* Treatments for Crohn's disease-associated bowel damage: A systematic review. *Clin Gastroenterol Hepatol* 2019;17:847-56.
2. Yaari S, Benson A, Aviran E, Lev Cohain N, Oren R, Sosna J, *et al.* Factors associated with surgery in patients with intra-abdominal fistulizing Crohn's disease. *World J Gastroenterol* 2016;22:10380-7.
3. Tarris G, de Rougemont A, Charkaoui M, Michiels C, Martin L, Belliot G. Enteric viruses and inflammatory bowel disease. *Viruses* 2021;13:104.
4. Loftus EV Jr. Crohn's disease: Why the disparity in mortality? *Gut* 2006;55:447-9.
5. Yasukawa S, Matsui T, Yano Y, Sato Y, Takada Y, Kishi M, *et al.* Crohn's disease-specific mortality: A 30-year cohort study at a tertiary referral center in Japan. *J Gastroenterol* 2019;54:42-52.
6. Guan Q. A comprehensive review and update on the pathogenesis of inflammatory bowel disease. *J Immunol Res* 2019;2019:7247238.
7. Mendoza JL, Lana R, Taxonera C, Alba C, Izquierdo S, Díaz-Rubio M. Extraintestinal manifestations in inflammatory bowel disease: Differences between Crohn's disease and Ulcerative colitis. *Med Clin (Barc)* 2005;125:297-300.
8. James Shah N, K Gupta N, Borg BB. A review of liver disorders in inflammatory bowel disease (IBD). *Clin Case Rep Rev* 2017;3:1-11.
9. Restellini S, Chazouillères O, Frossard JL. Hepatic manifestations of inflammatory bowel diseases. *Liver Int* 2017;37:475-89.
10. Lardièrre-Deguelte S, Ragot E, Amroun K, Piardi T, Dokmak S, Bruno O, *et al.* Hepatic abscess: Diagnosis and management. *J Visc Surg* 2015;152:231-43.
11. Jain AG, FaisalUddin M, Gllava I, Gordon D, Guan J. A rare case of Crohn's disease manifesting as a large liver abscess. *Cureus* 2018;10:e3758.
12. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, *et al.* PRISMA extension for scoping reviews (PRISMA-ScR): Checklist and explanation. *Ann Intern Med* 2018;169:467-73.
13. Murad MH, Sultan S, Haffar S, Bazerbachi F. Methodological quality

- and synthesis of case series and case reports. *BMJ Evid Based Med* 2018;23:60-3.
14. Brasitus TA, Cleri DJ, Szabo K. *Streptococcus* MG-intermedius (*S milleri*) hepatic abscesses in two patients with regional enteritis. *South Med J* 1983;76:1297-8.
 15. Greenstein AJ, Sachar DB, Lowenthal D, Goldofsky E, Aufses AH Jr. Pyogenic liver abscess in Crohn's disease. *Q J Med* 1985;56:505-18.
 16. Saverymattu SH, Keshavarzian A, Gibson R, Chadwick VS, Hodgson HJ. Hepatic abscesses associated with Crohn's disease detected by ¹¹¹Indium leucocyte scanning. *J Clin Gastroenterol* 1985;7:273-6.
 17. Mir-Madjlessi SH, McHenry MC, Farmer RG. Liver abscess in Crohn's disease. Report of four cases and review of the literature. *Gastroenterology* 1986;91:987-93.
 18. Teague M, Baddour LM, Wruble LD. Liver abscess: A harbinger of Crohn's disease. *Am J Gastroenterol* 1988;83:1412-4.
 19. Vakil N, Hayne G, Sharma A, Hardy DJ, Slutsky A. Liver abscess in Crohn's disease. *Am J Gastroenterol* 1994;89:1090-5.
 20. Tung JY, Johnson JL, Liacouras CA. Portal-mesenteric pylephlebitis with hepatic abscesses in a patient with Crohn's disease treated successfully with anticoagulation and antibiotics. *J Pediatr Gastroenterol Nutr* 1996;23:474-8.
 21. André M, Aumaitre O, Papo T, Kemeny JL, Vital-Durand D, Rousset H, *et al*. Disseminated aseptic abscesses associated with Crohn's disease: A new entity? *Dig Dis Sci* 1998;43:420-8.
 22. Narayanan S, Mada JP, Johny M, Varga G, Prakash B, Koshy A. Crohn's disease presenting as pyogenic liver abscess with review of previous case reports. *Am J Gastroenterol* 1998;93:2607-9.
 23. Talwar A, Edwards D, Moran BJ. Hepatic abscesses as the primary presentation of Crohn's disease. *J R Army Med Corps* 2000;146:37-8.
 24. Puli SR, Presti ME, Alpert MA. Splenic granulomas in Crohn disease. *Am J Med Sci* 2003;326:141-4.
 25. Famularo G, Tesi A, Luzi C, Prantera C, Ialongo P. A relapsing liver abscess in a patient with unrecognised Crohn's disease. *Dig Liver Dis* 2003;35:516.
 26. Hazzan D, Fishman E, Heller E, Chapman M, Bauer JJ. Liver abscess in Crohn's disease: A report of three cases. *Mt Sinai J Med* 2004;71:351-4.
 27. Margalit M, Elinav H, Ilan Y, Shalit M. Liver abscess in inflammatory bowel disease: Report of two cases and review of the literature. *J Gastroenterol Hepatol* 2004;19:1338-42.
 28. Navot-Mintzer D, Koren A, Shahbari A, Nussinson E, Sakran W. Liver abscesses as the presenting manifestation of Crohn's disease in an adolescent. *Inflamm Bowel Dis* 2006;12:666-7.
 29. Holstein A, Egberts EH, Von Herbay A. Rheumatoid-like nodules in the spleen: New extraintestinal manifestation of Crohn's disease? *J Gastroenterol Hepatol* 2006;21:295-8.
 30. Aguas M, Bastida G, Nos P, Beltrán B, Grueso JL, Grueso J. Septic thrombophlebitis of the superior mesenteric vein and multiple liver abscesses in a patient with Crohn's disease at onset. *BMC Gastroenterol* 2007;7:22.
 31. Baca B, Hamzaoglu I, Karahasanoğlu T, Hamzaoglu HO. Laparoscopic treatment of pyogenic liver abscess complicating Crohn's disease: A case report. *Turk J Gastroenterol* 2007;18:58-61.
 32. André MF, Piette JC, Kémény JL, Ninet J, Jégo P, Delèvaux I, *et al*. Aseptic abscesses: A study of 30 patients with or without inflammatory bowel disease and review of the literature. *Medicine (Baltimore)* 2007;86:145-61.
 33. Adimoolam V, Welch A, Soloway G, Abdelsayed G. Hepatic abscess in Crohn's disease: Does certolizumab increase the risk? *Am J Gastroenterol* 2009;104:S366.
 34. Zakout R, Fonseca M, Santos JM, Marques A, Távora I, Oliveira E, *et al*. Multiple aseptic liver abscesses as the initial manifestation of Crohn's disease: Report of a case. *Dis Colon Rectum* 2009;52:343-5.
 35. Ormerod C, Sarkar S, Woodcock B, White D, Lal S. Gastric ulcers and swollen kidneys: A rare diagnosis complicating Crohn's disease. *BMJ Case Rep* 2010;2010:bcr0320102809.
 36. Bernabeu JL, Leo E, Trigo C, Herrera JM, Sousa JM, Marquez JL. Crohn's disease and liver abscess due to *Pedococcus* sp. *Inflamm Bowel Dis* 2011;17:2207-8.
 37. McGreal S, Sayers R, Wurm P, West K. Crohn's disease presenting with pyogenic liver abscess: A case report. *Case Rep Gastrointest Med* 2012;2012:762480.
 38. Togashi J, Sugawara Y, Akamatsu N, Aoki T, Ijichi M, Tanabe M, *et al*. Resection of a methicillin-resistant *Staphylococcus aureus* liver abscess in a patient with Crohn's disease under infliximab treatment: A case report. *J Med Case Rep* 2013;7:36.
 39. Sakharpe AK, Sakharpe AK, Mirmanesh M, Dunn H, Wilhelm J, Badr AS, *et al*. A case and review of aseptic liver abscess in Crohn's disease. *Int J Colorectal Dis* 2016;31:787-8.
 40. Yang Y, Chen D. Treatment of aseptic liver abscess due to Crohn's disease using infliximab. *Clin Gastroenterol Hepatol* 2017;15:A27-8.
 41. Gaut D, Shull H, Bejjani A, Kahn D. Hepatic abscess in a returning traveler with Crohn's disease: Differentiating amebic from pyogenic liver abscess. *Case Rep Med* 2018;2018:9593865.
 42. Soliman Y, Soliman M, Ahmed H, Casey K. Hepatic abscess as an initial manifestation of Crohn disease in a patient with history of lymphoma. *Am J Gastroenterol* 2018;113:S1652.
 43. Pielage M, Vogels S, Hoencamp R, van den Bremer J. Treating pyogenic liver abscesses secondary to diverticulitis in a patient using immunosuppressants for Crohn's disease by performing a sigmoid colectomy. *BMJ Case Rep* 2019;12:bcr2019231031.
 44. Otheo E, de Blas A, Fortún J, Camarero C. Multiple liver abscesses in Crohn's disease in infliximab therapy, successfully treated with antibiotic therapy. *Rev Esp Quimioter* 2019;32:566-8.
 45. Rybinski F, Weisser M, Niess JH, Hruz P. Amoebic liver abscess in Crohn disease treated with Ustekinumab. *Inflamm Bowel Dis* 2020;26:e68.
 46. Fillman H, Riquelme P, Sullivan PD, Mansoor AM. Aseptic abscess syndrome. *BMJ Case Rep* 2020;13:bcr2020236437.
 47. AlGhamdi ZM, Boumarah DN, Alshammary S, Elbawab H. Pleural empyema as a complication of pyogenic liver abscess: Can the minimum achieve the optimal? A comparison of 3 approaches. *Am J Case Rep* 2021;22:e935169.
 48. Tagliaferri AR, Ruparel H, Melki G, Baddoura W. Liver abscess secondary to Crohn's disease: A case report. *Cureus* 2022;14:e23157.
 49. MacDonald P, Mercer C. Hepatic abscess associated with subclinical ulcerative colitis. *Can J Gastroenterol* 1989;3:123-5.
 50. Song J, Swekla M, Colorado P, Reddy R, Hoffmann S, Fine S. Liver abscess and diarrhea as initial manifestations of Ulcerative colitis: Case report and review of the literature. *Dig Dis Sci* 2003;48:417-21.
 51. Inoue T, Hirata I, Egashira Y, Ishida K, Kawakami K, Morita E, *et al*. Refractory Ulcerative colitis accompanied with cytomegalovirus colitis and multiple liver abscesses: A case report. *World J Gastroenterol* 2005;11:5241-4.
 52. Wells CD, Balan V, Smilack JD. Pyogenic liver abscess after colonoscopy in a patient with Ulcerative colitis. *Clin Gastroenterol Hepatol* 2005;3:A24.
 53. Ji JS, Kim HK, Kim SS, Cho YS, Chae HS, Kim CW, *et al*. Combined hepatic and splenic abscesses in a patient with Ulcerative colitis. *J Korean Med Sci* 2007;22:750-3.
 54. Khoudari G, Soota K, El-Daher N, Kothari T, Lingutla D. Liver abscess with Ulcerative colitis: A complication rarely seen. *Am J Gastroenterol* 2015;110:S378.
 55. Albuquerque A, Magro F, Rodrigues S, Lopes S, Pereira P, Melo RB, *et al*. Liver abscess of the caudate lobe due to *Staphylococcus aureus* in an Ulcerative colitis patient: First case report. *J Crohns Colitis* 2011;5:360-3.
 56. Veeramachaneni H, Robbins G, Samo S, Shah R, Sakaria S. Liver abscesses and primary sclerosing cholangitis in Ulcerative colitis: An unusual occurrence. *Am J Gastroenterol* 2018;113:S1287-8.

57. Kesar V, Swaminath A. Hepatic masses in a patient with inflammatory bowel disease. *Gastroenterology* 2018;154:e5-6.
58. Castillo DF, Caicedo R, Gopalareddy V. Liver abscess in a pediatric patient with Ulcerative colitis: A case presentation. *J Clin Transl Hepatol* 2019;7:93-6.
59. Hasan B, Khalid R, Charles R, Shen B. Abdominal pain in a patient with diverted bowel and inflammatory bowel disease. *ACG Case Rep J* 2020;7:e00437.
60. Yamaguchi Y, Nakagawa M, Nakagawa S, Nagao K, Inoue S, Sugiyama T, *et al*. Rapidly progressing aseptic abscesses in a patient with Ulcerative colitis. *Intern Med* 2021;60:725-30.
61. Yamaguchi A, Matsui T, Sakurai T, Ueki T, Nakabayashi S, Yao T, *et al*. The clinical characteristics and outcome of intraabdominal abscess in Crohn's disease. *J Gastroenterol* 2004;39:441-8.
62. Makowiec F, Jehle EC, Becker HD, Starlinger M. Perianal abscess in Crohn's disease. *Dis Colon Rectum* 1997;40:443-50.
63. Lin JN, Lin CL, Lin MC, Lai CH, Lin HH, Kao CH. Pyogenic liver abscess in patients with inflammatory bowel disease: A nationwide cohort study. *Liver Int* 2016;36:136-44.
64. Li S, Ney M, Eslamparast T, Vandermeer B, Ismond KP, Kroeker K, *et al*. Systematic review of nutrition screening and assessment in inflammatory bowel disease. *World J Gastroenterol* 2019;25:3823-37.
65. Sinha D, Sun X, Khare M, Drancourt M, Raoult D, Fournier PE. Pangenome analysis and virulence profiling of *Streptococcus intermedius*. *BMC Genomics* 2021;22:522.
66. Issa E, Salloum T, Tokajian S. From normal flora to brain abscesses: A review of *Streptococcus intermedius*. *Front Microbiol* 2020;11:826.
67. Serraino C, Elia C, Bracco C, Rinaldi G, Pomero F, Silvestri A, *et al*. Characteristics and management of pyogenic liver abscess: A European experience. *Medicine (Baltimore)* 2018;97:e0628.
68. Trefond L, Frances C, Costedoat-Chalumeau N, Piette JC, Haroche J, Sailer L, *et al*. Aseptic abscess syndrome: Clinical characteristics, associated diseases, and up to 30 years' evolution data on a 71-patient series. *J Clin Med* 2022;11:3669.
69. Bollegala N, Khan R, Scaffidi MA, Al-Mazroui A, Tessolini J, Showler A, *et al*. Aseptic abscesses and inflammatory bowel disease: Two cases and review of literature. *Can J Gastroenterol Hepatol* 2017;2017:5124354.
70. Maconi G, Sampietro GM, Parente F, Pompili G, Russo A, Cristaldi M, *et al*. Contrast radiology, computed tomography and ultrasonography in detecting internal fistulas and intra-abdominal abscesses in Crohn's disease: A prospective comparative study. *Am J Gastroenterol* 2003;98:1545-55.
71. Sharma MP, Ahuja V. Management of amebic and pyogenic liver abscess. *Indian J Gastroenterol* 2001;20 Suppl 1:C33-6.
72. Dariushnia SR, Mitchell JW, Chaudry G, Hogan MJ. Society of interventional radiology quality improvement standards for image-guided percutaneous drainage and aspiration of abscesses and fluid collections. *J Vasc Interv Radiol* 2020;31:662-6.e4.
73. Cadar R, Trofin AM, Zabara M, Nastase A, Fotea V, Lupascu-Ursulescu C, *et al*. The use of mucolytic agent in percutaneous drainage of liver abscess: A case-series analysis. *Chirurgia (Bucur)* 2021;116:473-9.
74. Singh O, Gupta S, Moses S, Jain DK. Comparative study of catheter drainage and needle aspiration in management of large liver abscesses. *Indian J Gastroenterol* 2009;28:88-92.
75. Rajak CL, Gupta S, Jain S, Chawla Y, Gulati M, Suri S. Percutaneous treatment of liver abscesses: Needle aspiration versus catheter drainage. *AJR Am J Roentgenol* 1998;170:1035-9.

Supplementary Table 1: Published case reports and series of liver abscess associated with Crohn's disease

Author(s)	Year of publication	Age (years)/sex (male/female)	Clinical presentation	Causative organism	Comorbidities	HA characteristics	CD duration/activity status	Management	Outcome
Brasitus <i>et al.</i> ^[14]	1983	62/male	Fever, fatigue and anorexia for 2 months	<i>S. intermedius</i>	None	Solitary lesion involving the right hepatic lobe	34 years/poorly controlled	Abx and PD	Clinical improvement
Brasitus <i>et al.</i> ^[14]	1983	23/male	Night sweats and fever for 4 days	<i>S. intermedius</i>	None	Several lesions involving both hepatic lobes	3 years/well-controlled	Abx and PD	Clinical improvement
Greenstein <i>et al.</i> ^[15]	1985	57/female	Rectal bleeding, vomiting, abdominal distension and diarrhea for 1 week	<i>E. coli</i> and <i>P. mirabilis</i>	Rheumatoid arthritis and systemic amyloidosis	Solitary lesion involving the right hepatic lobe	3 months/poorly controlled	Abx	Death
Greenstein <i>et al.</i> ^[15]	1985	75/female	Abdominal pain, fever and weight loss for 6 months	Culture not performed	Peptic ulcer disease and malnutrition	Several hepatic lesions	20 years/poorly controlled	Abx	Death
Greenstein <i>et al.</i> ^[15]	1985	54/male	Abdominal pain, fever and weight loss	<i>S. albus</i>	None	Solitary hepatic lesion	14 years/poorly controlled	Abx and surgical drainage	Clinical improvement
Greenstein <i>et al.</i> ^[15]	1985	37/male	Vomiting and fever for 1 day	Culture not performed	None	Solitary lesion involving the right hepatic lobe	3 years/well-controlled	Abx	Clinical improvement
Greenstein <i>et al.</i> ^[15]	1985	50/male	Fever and weight loss	Culture not performed	Renal failure and malnutrition	Solitary lesion involving the right hepatic lobe	4 years/poorly controlled	Abx and PD	Clinical improvement
Greenstein <i>et al.</i> ^[15]	1985	67/female	Fever and diarrhea for 1 week	Culture not performed	Sigmoid cancer	Several lesions within the right hepatic lobe along with hepatic metastasis	11 years/poorly-controlled	Abx, corticosteroids and surgical drainage	Death
Saverymuttu <i>et al.</i> ^[16]	1985	71/female	Fever	Culture not performed	None	Several lesions involving both hepatic lobes	3 years/well-controlled	PD and surgical drainage	Clinical improvement
Mir-Madjlessi <i>et al.</i> ^[17]	1986	21/male	Diarrhea, abdominal pain and fever	<i>P. mirabilis</i>	Malnutrition	Several lesions	Long-standing	Abx, corticosteroids and surgical drainage	Death
Mir-Madjlessi <i>et al.</i> ^[17]	1986	45/female	Abdominal pain and fever	α -hemolytic <i>Streptococcus</i> and <i>Enterococcus</i> species	None	Several lesions within the right hepatic lobe	3 months/poorly-controlled	Abx and surgical drainage	Clinical improvement
Mir-Madjlessi <i>et al.</i> ^[17]	1986	28/male	Fever	<i>F. nucleatum</i>	Malnutrition	Several hepatic lesions	Long-standing/poorly-controlled	Abx, PD and surgical drainage	Clinical improvement with long hospital stay

Contd...

Supplementary Table 1: Contd...

Author(s)	Year of publication	Age (years)/sex (male/female)	Clinical presentation	Causative organism	Comorbidities	HA characteristics	CD duration/activity status	Management	Outcome
Mir-Madjlessi et al. ^[17]	1986	35/male	Fever, weight loss, night sweats and anorexia for 2 weeks	<i>S. intermedius</i>	None	Solitary lesion involving the right hepatic lobe	1 year	Abx and PD	Clinical improvement
Teague et al. ^[18]	1988	24/male	Fever, weight loss, abdominal pain and cough for 5 weeks	Culture not performed	None	Solitary lesion involving the right hepatic lobe	HA was the initial manifestation of CD	Abx, PD and surgical drainage	Clinical improvement
Vakil et al. ^[19]	1994	6 patients were included with age range (17-87)/5 males and 1 female	All patients had fever, 3 had abdominal pain and 4 had diarrhea	<i>Streptococci</i> were the most commonly identified (4 of 6 patients); one patient also had <i>E. coli</i> , and 2 had only <i>S. aureus</i>	One of the included patients (87 years) had IHD and COPD	All patients had abscesses in the right lobe of the liver. 1 patient had involvement of both lobes	The interval between CD diagnosis and development of abscess ranged between 0-21 years. 3 patients presented as the initial manifestation of CD	4 patients were treated successfully with PD, 1 required surgical drainage and 1 liver resection	Clinical improvement in 5 patients and death in 1 patient (87 years)
Tung et al. ^[20]	1996	18/female	Abdominal pain, fever, diarrhea and weight loss	Trial of culture was unsuccessful	None	Several lesions involving both hepatic lobes	8 years	Abx	Clinical improvement with long hospital stay
André et al. ^[21]	1998	25/male	Fever, diarrhea, abdominal pain and weight loss for 3 months	Aseptic	Hepatitis B	Not specified	HA was the initial manifestation of CD	Abx and corticosteroids	Clinical improvement
André et al. ^[21]	1998	16/male	Fever, diarrhea and abdominal pain for 6 months	Aseptic	None	Not specified	HA was the initial manifestation of CD	Abx and corticosteroids	Clinical improvement
André et al. ^[21]	1998	23/female	Fever and abdominal pain for 6 months	Aseptic	None	Not specified	HA was the initial manifestation of CD	Abx and corticosteroids	Clinical improvement
Narayanan et al. ^[22]	1998	40/male	Fever for 12 days	<i>S. intermedius</i>	Tuberculosis	Several lesions involving both hepatic lobes	HA was the initial manifestation of CD	Abx and repetitive aspirations	Clinical improvement
Talwar et al. ^[23]	2000	49/male	Abdominal pain, weight loss and fever for 3 weeks	<i>M. streptococcus</i>	None	Several lesions within the right hepatic lobe	HA was the initial manifestation of CD	Abx and PD	Clinical improvement
Puli et al. ^[24]	2003	42/male	Fever and abdominal pain for 2 months	Aseptic	None	Several lesions within the right hepatic lobe	10 years	Corticosteroids	Clinical improvement

Contd...

Supplementary Table 1: Contd...

Author(s)	Year of publication	Age (years)/sex (male/female)	Clinical presentation	Causative organism	Comorbidities	HA characteristics	CD duration/activity status	Management	Outcome
Famularo <i>et al.</i> ^[25]	2003	37/male	Abdominal pain and fever for 3 months	Aseptic	None	Solitary lesion within the right hepatic lobe	HA was the initial manifestation of CD	Abx and multiple aspirations	Clinical improvement
Hazzan <i>et al.</i> ^[26]	2004	52/male	Fever and abdominal pain for 2 weeks	Aseptic	None	Several lesions within the right hepatic lobe	HA was the initial manifestation of CD	Abx, mesalamine and PD followed by surgical drainage	Clinical improvement
Hazzan <i>et al.</i> ^[26]	2004	23/male	Fever and abdominal pain for 3 weeks	<i>S. viridans</i>	None	Several lesions within the right hepatic lobe	1 year	Abx, corticosteroids, PD and surgical drainage	Clinical improvement
Hazzan <i>et al.</i> ^[26]	2004	56/male	Fever and cough for 10 days	Gram positive cocci	None	Solitary lesion within the right hepatic lobe	30 years	Abx, PD followed by surgical drainage	Clinical improvement
Margalit <i>et al.</i> ^[27]	2004	41/male	Septic shock	<i>E. coli</i> , <i>M. morganii</i> and <i>S. faecalis</i>	PSC	Solitary lesion within the right hepatic lobe	2 years/poorly controlled	Abx and PD	Death
Navot-Mintzer <i>et al.</i> ^[28]	2006	17/male	Abdominal pain, weight loss and diarrhea	Culture not performed	None	Several hepatic lesions	HA was the initial manifestation of CD	Abx	Clinical improvement
Holstein <i>et al.</i> ^[29]	2006	26/male	Fever, weight loss and diarrhea	Aseptic	Sacroiliitis	Several lesions involving both hepatic lobes	2 years/well-controlled	Corticosteroids	Clinical improvement
Aguas <i>et al.</i> ^[30]	2007	25/male	Fever and abdominal pain for 7 days	<i>Peptostreptococcus</i> species and <i>P. acnes</i>	None	Several lesions involving both hepatic lobes	4 years	Abx and PD	Clinical improvement with long hospital stay
Baca <i>et al.</i> ^[31]	2007	41/male	Abdominal pain and fever for 2 weeks	<i>S. intermedius</i>	None	Solitary lesion within the right hepatic lobe	3 years/well-controlled	Abx, PD and surgical drainage	Clinical improvement
André <i>et al.</i> ^[32]	2007	30/female	Abdominal pain, fever and weight loss	Aseptic	None	Not documented	3 years	Corticosteroids	Clinical improvement
André <i>et al.</i> ^[32]	2007	22/male	Fever and weight loss	Aseptic	None	HA was the initial manifestation of CD	6 months	Corticosteroids and infliximab	Clinical improvement
André <i>et al.</i> ^[32]	2007	16/male	Abdominal pain, fever and weight loss	Aseptic	None	Corticosteroids	Clinical improvement	Corticosteroids	Clinical improvement
André <i>et al.</i> ^[32]	2007	10/male	Abdominal pain and fever	Aseptic	Ankylosing spondylitis	1 year	1 year	Corticosteroids and methotrexate	Clinical improvement

Contd...

Supplementary Table 1: Contd...

Author(s)	Year of publication	Age (years)/sex (male/female)	Clinical presentation	Causative organism	Comorbidities	HA characteristics	CD duration/activity status	Management	Outcome
André <i>et al.</i> ^[32]	2007	25/female	Abdominal pain, fever, diarrhea and weight loss	Aseptic	None		HA was the initial manifestation of CD	Corticosteroids	Clinical improvement
André <i>et al.</i> ^[32]	2007	24/male	Abdominal pain, fever, diarrhea and night sweats	Aseptic	Psoriasis		HA was the initial manifestation of CD	Corticosteroids	Clinical improvement
Adimoolam <i>et al.</i> ^[33]	2009	14/male	Abdominal pain and distension for 3 days	<i>S. intermedius</i>	None	Solitary lesion within the right hepatic lobe	Poorly controlled	Abx and PD	Clinical improvement
Zakout <i>et al.</i> ^[34]	2009	29/female	Fever, abdominal pain, diarrhea and chest pain for 1 week	Aseptic	None	Several lesions involving both hepatic lobes	HA was the initial manifestation of CD	Sulfasalazine and azathioprine	Clinical improvement with long hospital stay
Ormerod <i>et al.</i> ^[35]	2010	48/female	Fever and abdominal pain	Culture not performed	None	Solitary lesion within the left hepatic lobe	8 years/well-controlled	Abx	Clinical improvement
Bernabeu <i>et al.</i> ^[36]	2011	27/female	Fever and cough	<i>Pedococcus</i> species	None	Solitary lesion within the right hepatic lobe	15 years	Abx and PD	Clinical improvement
McGreal <i>et al.</i> ^[37]	2012	18/male	Fatigue, weight loss, night sweats, anorexia and diarrhea for 13 days	<i>S. intermedius</i>	Malnutrition	Solitary lesion within the right hepatic lobe	HA was the initial manifestation of CD	Abx and PD	Clinical improvement
Togashi <i>et al.</i> ^[38]	2013	31/male	Fever and abdominal pain	MRSA and <i>E. coli</i>	None	Solitary lesion within the right hepatic lobe	15 years	Abx and PD followed by surgical resection	Clinical improvement with long hospital stay
Sakharpe <i>et al.</i> ^[39]	2016	48/female	Fever and anorexia for 1 month	Aseptic	None	Solitary mass within the left hepatic lobe	15 years/well-controlled	Corticosteroids, Abx and PD	Clinical improvement
Yang and Chen ^[40]	2017	14/female	Abdominal pain, anorexia, and fever for 2 weeks	Aseptic	None	Several lesions within the right hepatic lobe	1 year/poorly controlled	Abx and infliximab	Clinical improvement
Gaut <i>et al.</i> ^[41]	2018	28/male	Abdominal pain and fever	<i>E. histolytica</i>	None	Solitary lesion within the left lobe	Long-standing/well-controlled	Abx and PD	Clinical improvement
Soliman <i>et al.</i> ^[42]	2018	28/female	Abdominal pain, nausea, vomiting and fever	Culture not performed	Treated lymphoma	Solitary lesion within the left lobe	HA was the initial manifestation of CD	Abx and PD	Clinical improvement
Jain <i>et al.</i> ^[11]	2018	55/female	Fever, diarrhea and weight loss for 6 months	<i>S. viridans</i>	Hypertension	Several lesions within the left hepatic lobe	2 years/well-controlled	Abx and PD	Clinical improvement

Contd...

Supplementary Table 1: Contd...

Author(s)	Year of publication	Age (years)/sex (male/female)	Clinical presentation	Causative organism	Comorbidities	HA characteristics	CD duration/activity status	Management	Outcome
Pielage <i>et al.</i> ^[43]	2019	54/male	Low back pain and night sweats for 2 weeks	<i>S. intermedius</i>	Sigmoid diverticulosis	Several lesion within the right hepatic lobe	6 years/well-controlled	Abx and PD	Clinical improvement with long hospital stay
Otheo <i>et al.</i> ^[44]	2019	14/male	Fever and vomiting for 1 day	Aseptic	None	Several lesions involving both hepatic lobes	21 months	Abx	Clinical improvement with long hospital stay
Rybinski <i>et al.</i> ^[45]	2020	50/male	Fever and abdominal pain	<i>E. histolytica</i>	None	Solitary lesion within the right hepatic lobe	6 months/poorly-controlled	Abx and aspiration	Clinical improvement
Fillman <i>et al.</i> ^[46]	2020	43/female	Abdominal pain, fever, diarrhea and weight loss for 1 week	Aseptic	None	Several lesion within the right hepatic lobe	Poorly controlled	Corticosteroids	Clinical improvement
AlGhamdi <i>et al.</i> ^[47]	2021	29/male	Abdominal pain, distension, fever, constipation and dyspnea for 1 week	<i>S. intermedius</i>	Malnutrition	Several lesions involving both hepatic lobes	2 months	PD	Clinical improvement with long hospital stay
Tagliaferri <i>et al.</i> ^[48]	2022	45/male	Abdominal pain and fever for 3 weeks	Aseptic	None	Several lesions involving both hepatic lobes	Well-controlled	Abx and PD	Clinical improvement

HA – Hepatic abscess; CD – Crohn's disease; Abx – Antibiotics; PD – Percutaneous drainage; IHD – Ischemic heart disease; COPD – Chronic obstructive pulmonary disease; PSC – Primary sclerosing cholangitis; *E. coli* – *Escherichia coli*; *S. intermedius* – *Streptococcus intermedius*; *S. albus* – *Staphylococcus albus*; *P. mirabilis* – *Proteus mirabilis*; *F. nucleatum* – *Fusobacterium nucleatum*; *S. aureus* – *Staphylococcus aureus*; *S. viridans* – *Streptococcus viridans*; *M. morgani* – *Morganella morgani*; *S. faecalis* – *Streptococcus faecalis*; *P. acnes* – *Propionibacterium acnes*; *E. histolytica* – *Entamoeba histolytica*; MRSA – Methicillin-resistant *S. aureus*; *M. streptococcus* – *Microaerophilic streptococcus*

Supplementary Table 2: Published case reports and series of liver abscess associated with ulcerative colitis

Author(s)	Year of publication	Age (years)/ sex (male/female)	Clinical presentation	Causative organism	Comorbidities	HA characteristics	UC duration and activity status	Management	Outcome
Macdonald and Mercer ^[49]	1989	45/male	Fever and weight loss for 2 weeks	Aseptic	None	Solitary lesion within the right hepatic lobe	HA was the initial manifestation of UC	Abx and surgical drainage	Clinical improvement
Song <i>et al.</i> ^[50]	2003	84/female	Diarrhea for 19 days and fever for 2 days	<i>S. intermedium</i>	Hypertension and diverticulosis	Several lesions involving both hepatic lobes	HA was the initial manifestation of UC	Abx and PD	Clinical improvement
Margalit <i>et al.</i> ^[27]	2004	58/male	Fever and night sweats for 6 weeks	<i>S. intermedium</i>	Diverticulosis and PSC	Several lesions involving both hepatic lobes	10 years/ well-controlled	Abx	Clinical improvement
Inoue <i>et al.</i> ^[51]	2005	72/male	Bloody diarrhea for 1 month	<i>E. fecalis</i>	None	Several lesions involving the right hepatic lobe	5 years/poorly controlled	Abx	Clinical improvement with long hospital stay
Wells <i>et al.</i> ^[52]	2005	62/male	Fever for 2 weeks	<i>F. nucleatum</i>	None	Several lesions involving the right hepatic lobe	20 years back/ well-controlled	Abx and PD	Clinical improvement
Ji <i>et al.</i> ^[53]	2007	18/female	Diarrhea for 1 month	Aseptic	None	Several lesions involving the right hepatic lobe	HA was the initial manifestation of UC	Abx and PD	Clinical improvement
André <i>et al.</i> ^[52]	2007	25/female	Abdominal pain and fever	Aseptic	None	Not documented	3 years	Corticosteroids	Clinical improvement
Khoudari <i>et al.</i> ^[54]	2015	50/male	Abdominal pain and fever for 1 week	α -hemolytic <i>Streptococcus</i>	None	Several lesions involving both hepatic lobes	Well-controlled	Abx and PD	Clinical improvement
Albuquerque <i>et al.</i> ^[55]	2011	67/male	Abdominal pain and fever	Aseptic	Benign prostatic hyperplasia PSC	Several lesions involving the right hepatic lobe	1 year	Abx and PD	Clinical improvement
Veeramachaneni <i>et al.</i> ^[56]	2018	40/male	Abdominal pain and bloody diarrhea for 8 months	Not performed	None	Several lesions involving the right hepatic lobe	HA was the initial manifestation of UC	Abx	Clinical improvement
Kesar and Swaminath ^[57]	2018	74/female	Abdominal pain and bloody diarrhea for 3 weeks	<i>S. intermedium</i>	None	Several lesions involving the right hepatic lobe	34 years/ well-controlled	Abx	Clinical improvement
Castillo <i>et al.</i> ^[58]	2019	16/male	Abdominal pain, fever, jaundice and fatigue	<i>Peptostreptococcus</i> and <i>E. coli</i>	None	Several lesions involving the right hepatic lobe	2 years	Abx and surgical drainage	Clinical improvement with long hospital stay
Hasan <i>et al.</i> ^[59]	2020	46/female	Abdominal pain and increased stoma output for 3 weeks	<i>S. intermedium</i> and <i>P. micra</i>	None	Solitary lesion within the right hepatic lobe	24 years/ well-controlled	Abx and PD	Clinical improvement
Yamaguchi <i>et al.</i> ^[60]	2021	45/male	Fever, weight loss and abdominal pain for 3 days	Aseptic	Ankylosing spondylitis	Solitary lesion within the right hepatic lobe	30 years/ well-controlled	Abx, infliximab and granulocytapheresis	Clinical improvement

HA – Hepatic abscess; UC – Ulcerative colitis; Abx – Antibiotics; PD – Percutaneous drainage; PSC – Primary sclerosing cholangitis; *S. intermedium* – *Streptococcus intermedium*; *E. fecalis* – *Enterococcus fecalis*; *F. nucleatum* – *Fusobacterium nucleatum*; *P. micra* – *Parvimonas micra*; *E. coli* – *Escherichia coli*

Supplementary Table 3: Qualitative assessment of the included studies

Article	Domains for evaluating the methodological quality of included case series and case reports							
	Selection	Ascertainment		Causality			Reporting	
	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8
Greenstein <i>et al.</i> ^[15]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Mir-Madjlessi <i>et al.</i> ^[17]	Yes	Yes	Yes	Yes	No	No	Yes	No
Teague <i>et al.</i> ^[18]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Vakil <i>et al.</i> ^[19]	Yes	Yes	Yes	Yes	No	No	Yes	No
Tung <i>et al.</i> ^[20]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
André <i>et al.</i> ^[21]	Yes	Yes	Yes	Yes	No	No	Yes	No
Narayanan <i>et al.</i> ^[22]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Talwar <i>et al.</i> ^[23]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Puli <i>et al.</i> ^[24]	Yes	Yes	Yes	Yes	No	No	Yes	No
Famularo <i>et al.</i> ^[25]	Yes	Yes	Yes	Yes	No	No	Yes	No
Hazzan <i>et al.</i> ^[26]	Yes	Yes	Yes	Yes	No	No	Yes	No
Margalit <i>et al.</i> ^[27]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Navot-Mintzer <i>et al.</i> ^[28]	Yes	Yes	Yes	Yes	No	No	Yes	No
Holstein <i>et al.</i> ^[29]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Aguas <i>et al.</i> ^[30]	Yes	Yes	Yes	Yes	No	No	Yes	No
Baca <i>et al.</i> ^[31]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
André <i>et al.</i> ^[32]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Adimoolam <i>et al.</i> ^[33]	Yes	Yes	No	Yes	Yes	Yes	Yes	No
Zakout <i>et al.</i> ^[34]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Ormerod <i>et al.</i> ^[35]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Bernabeu <i>et al.</i> ^[36]	Yes	Yes	Yes	Yes	No	No	Yes	No
McGreal <i>et al.</i> ^[37]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Togashi <i>et al.</i> ^[38]	Yes	Yes	Yes	Yes	No	No	Yes	No
Sakharpe <i>et al.</i> ^[39]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Yang <i>et al.</i> ^[40]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Gaut <i>et al.</i> ^[41]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Soliman <i>et al.</i> ^[42]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Jain <i>et al.</i> ^[11]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Pielage <i>et al.</i> ^[43]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Otheo <i>et al.</i> ^[44]	Yes	Yes	Yes	Yes	No	No	Yes	No
Saverymuttu <i>et al.</i> ^[16]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Rybinski <i>et al.</i> ^[45]	Yes	Yes	Yes	Yes	No	No	Yes	No
Fillman <i>et al.</i> ^[46]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
AlGhamdi <i>et al.</i> ^[47]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Tagliaferri <i>et al.</i> ^[48]	Yes	Yes	Yes	Yes	No	No	Yes	No
Brasitus <i>et al.</i> ^[14]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Macdonald <i>et al.</i> ^[49]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Song <i>et al.</i> ^[50]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Inoue <i>et al.</i> ^[51]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Wells <i>et al.</i> ^[52]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Ji <i>et al.</i> ^[53]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Khoudari <i>et al.</i> ^[54]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Albuquerque <i>et al.</i> ^[55]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Veeramachaneni <i>et al.</i> ^[56]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Kesar <i>et al.</i> ^[57]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Castillo <i>et al.</i> ^[58]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Hasan <i>et al.</i> ^[59]	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Yamaguchi <i>et al.</i> ^[60]	Yes	Yes	Yes	Yes	No	No	Yes	Yes

Question 1: Does the patient(s) represent(s) the whole experience of the investigator (center) or is the selection method unclear to the extent that other patients with similar presentation may not have been reported?

Question 2: Was the exposure adequately ascertained?

Question 3: Was the outcome adequately ascertained?

Question 4: Were other alternative causes that may explain the observation ruled out?

Question 5: Was there a challenge/rechallenge phenomenon?

Question 6: Was there a dose– response effect?

Question 7: Was follow-up long enough for outcomes to occur?

Question 8: Is the case(s) described with sufficient details to allow other investigators to replicate the research or to allow practitioners make inferences related to their own practice?