Radiography 27 (2021) 716–720

Contents lists available at ScienceDirect

Radiography

journal homepage: www.elsevier.com/locate/radi

Systematic Review

CT features of toxic megacolon: A systematic review

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ARTICLE INFO

Article history:
Received 8 July 2020
Received in revised form
22 October 2020
Accepted 28 October 2020
Available online 12 November 2020

Keywords:
Toxic megacolon
Computed tomography
Radiographic features

ABSTRACT

Introduction: Toxic megacolon is a rare but life-threatening condition. Diagnosis is made when both systemic toxicity and an enlarged colon are present. We undertook a systematic review of the literature to provide a list of toxic megacolon findings on computed tomography (CT) imaging along with the prevalence rate for each finding.

Methods: PubMed, Embase, and Cochrane library were searched. After eligibility screening and quality assessment, the reported CT findings of toxic megacolon with their respective prevalence rates were extracted from the included studies. Pooled prevalence rates were calculated for each finding using random-effects model and inverse variance method. I^2 statistics were used to estimate the heterogeneity. All statistical analyses were performed using R software. P-values less than 0.05 were considered significant.

Results: Database search yielded a total of 122 records. Only 2 of these studies were finally selected following two-step eligibility screening. Most common CT features of toxic megacolon and their pooled prevalence rates [95% CI] were: colonic distension (reported in 100% of patients), abnormal haustration 96% [0.75–0.99], peri-colonic fat stranding 87% [0.29–0.99], nodular pseudo polyps 76% [0.52–0.91], multilayered appearance of colonic wall 58% [0.38–0.76], and ascites 57% [0.21–0.87]. Other reported CT features: colonic wall thickening, pleural effusion, accordion sign, small bowel/gastric distension, and segmental colonic wall thinning.

Conclusion: and implication for practice: Colonic distension can be accompanied by 10 other findings in CT images of patients with toxic megacolon. Although these findings are not specific, toxic megacolon should be included in the list of differential diagnoses when these findings are present.

Introduction

Toxic megacolon is mainly recognised as the complication of ulcerative colitis (UC)[1] and Crohn's disease.[2] A retrospective study of 1236 inflammatory bowel disease (IBD) patients in 1985 demonstrated from 613 UC patients and 623 Crohn's disease patients, 61 (10%) patients and 14 (2.3%) patients developed toxic megacolon, respectively.[3]

The pathogenesis of toxic megacolon is not fully understood. However, extension of the inflammation from mucosal layer to the muscularis layer of colon wall is one of the proposed mechanisms.[4] Inflammation of the muscularis layer leads to paralysis of the colon wall and finally dilation of the colon.[4]

Although IBD is the most recognised underlying condition for development of toxic megacolon,[4] other aetiological conditions have also been proposed. Infective colitis with bacteria (Escherichia Coli,[5] salmonella,[6,7] shigella,[8] campylobacter,[9] yersinia,[10] and clostridium difficile[11,12]), parasites (entamoeba histolytica,[13] cryptosporidium[14]), viruses (cytomegalovirus[15]), and fungi (aspergillosis[16]) are among the most commonly reported conditions. In addition, ischemic colitis can also cause toxic megacolon.[17,18] There is one report of toxic megacolon complicating intestinal Behçet's disease.[19] Toxic megacolon has also been reported as a complication of drug Clozapine.[20]

Diagnostic criteria for toxic megacolon were first described by Jalan et al.[21]: "The patient must have evidence of colonic dilation (radiographical or clinical) plus evidence of toxicity (three of the following: fever > 38 °C, tachycardia >120 beats per minute,

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https://doi.org/10.1016/j.radi.2020.10.019
1078-8174/

leukocytosis >10,500/microL, and anaemia) plus (one of the following: dehydration, mental changes, electrolyte disturbance and hypotension)".

Evidence for colonic dilation is usually provided using abdominal X-ray imaging. Transverse colon is usually the most commonly and most severely dilated part of the colon due to physical reasons.[21] Abdominal X-rays may also reveal air-fluid levels in the colon, absent/distorted colonic haustral pattern,[4] and pseudo polyps.

Historically, abdominal radiography has been the commonest imaging modality used in investigating toxic megacolon. However, Computed tomography (CT) scans may have some advantages over X-ray imaging. It has been reported that CT can better identify the complications of toxic megacolon.[4] It has also been proposed that in some cases CT can help identifying the underlining cause of toxic megacolon.[4]

To the best of our knowledge no study has reviewed the CT features of toxic megacolon so far. We performed a systematic review of the literature to provide radiologists and clinicians with a list of the CT features of toxic megacolon along with each feature's prevalence rate.

Methods

This study was approved by our Institutional Review Board (IRB) Committee with the registration number (blinded for review process). The manuscript was drafted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[22]

Database search

Based on PICO (Population, Intervention, Comparison, and Outcome) our target Population was toxic megacolon patients, Intervention was CT, Outcome was features reported on CT, and we did not have any Comparison. We identified MeSH terms and synonyms for our search terms through a preliminary search of PubMed. The term "toxic colitis" appeared to be used as synonym for "toxic megacolon" in literature. However, we evaluated the full text of articles using "toxic colitis" term meticulously to avoid misunderstanding. PubMed, Embase, and Cochrane library were searched using search strategies designed by an experienced medical information specialist in consultation with other authors. Search strategies are provided in Supplement 1.

Reference list of the retrieved studies were also hand searched. Endnote (X9, Thomson Reuters) was used for reference management and removal of duplications.

Eligibility screening

Two of the topic expert authors independently evaluated the retrieved records. First, at the level of title and abstract, they chose to exclude the study types other than original research. Second, at the level of full text, they excluded irrelevant studies based on PICO specifications. It was predetermined that in cases of disagreements, authors would have a meeting and come to a consensus through discussion.

Data extraction

The same two authors extracted data from the selected studies independently into a predesigned table. Data extracted included the title of the study, DOI, first author, country of origin, date of publication, gender and mean age of the patients, type of the study, sample size, reported CT findings, number and percentage of patients having each finding, authors explanations regarding each finding, proposed aetiology of toxic megacolon for each patient, secondary complications of toxic megacolon. After data extraction was completed, authors had a discussion meeting and resolved the disagreements.

In a few cases different terms appeared to be used to describe identical image findings. These were discussed between topic expert authors and a single term was chosen to represent that finding.

Critical appraisal

For quality assessment, we used the Joanna Briggs Institute (JBI) Critical Appraisal Checklists. The Checklist designed for Studies Reporting Prevalence Data[23] was used. More details are provided in Supplement 1.

Statistical analysis

The prevalence of each CT finding was extracted from the studies and pooled prevalence was calculated for each finding. All statistical analyses were performed using R (R Core Team, 2020)[24] with "meta" package[25] and "metaprop" function. P-values less than 0.05 were considered significant. Details of the statistical analyses performed are again provided in Supplement 1.

Results

Study selection and study characteristics

PubMed, Embase and Cochrane library searches revealed a total of 122 records, two of which were finally selected after two step eligibility screening.[26,27] A PRISMA flow diagram of the study is shown in Fig. 1. These two studies were estimated to have a low risk for bias. Critical appraisal results are provided in Supplement 2. The characteristics of the two selected studies are shown in Table 1.

Reported CT features for toxic megacolon and prevalence rates

Colonic distension >6 cm, abnormal haustral pattern, nodular pseudo polyps, diffuse colonic wall thickening, multilayered appearance of colonic wall, accordion sign, segmental colonic wall thinning, peri colonic fat stranding, ascites, pleural effusion, small bowel and gastric distension were the reported CT features in toxic megacolon.[26,27] A typical example of each finding is shown in Fig. 2.

The reported prevalence of each CT finding along with their pooled prevalence have been shown in Table 2. For diffuse colonic wall thickening, I^2 statistics showed 79% between-study heterogeneity ($p = 0.03$) which prevented us from performing a meta-analysis. Three of the findings were only reported in one of the studies, again preventing a meta-analysis.

Discussion

Our study shows that colonic distension > 6 cm, abnormal haustration, nodular pseudo polyps, peri colonic fat stranding, ascites, and multilayered appearance of colonic wall are the most prevalent CT features of toxic megacolon. It should be noted that our study does not provide any information regarding the sensitivity or specificity of each CT finding. The aim of our study was only to provide a list of CT features of toxic megacolon and also provide an approximate estimate of the prevalence rate of each finding. It has been generally recommended not to perform meta-analysis

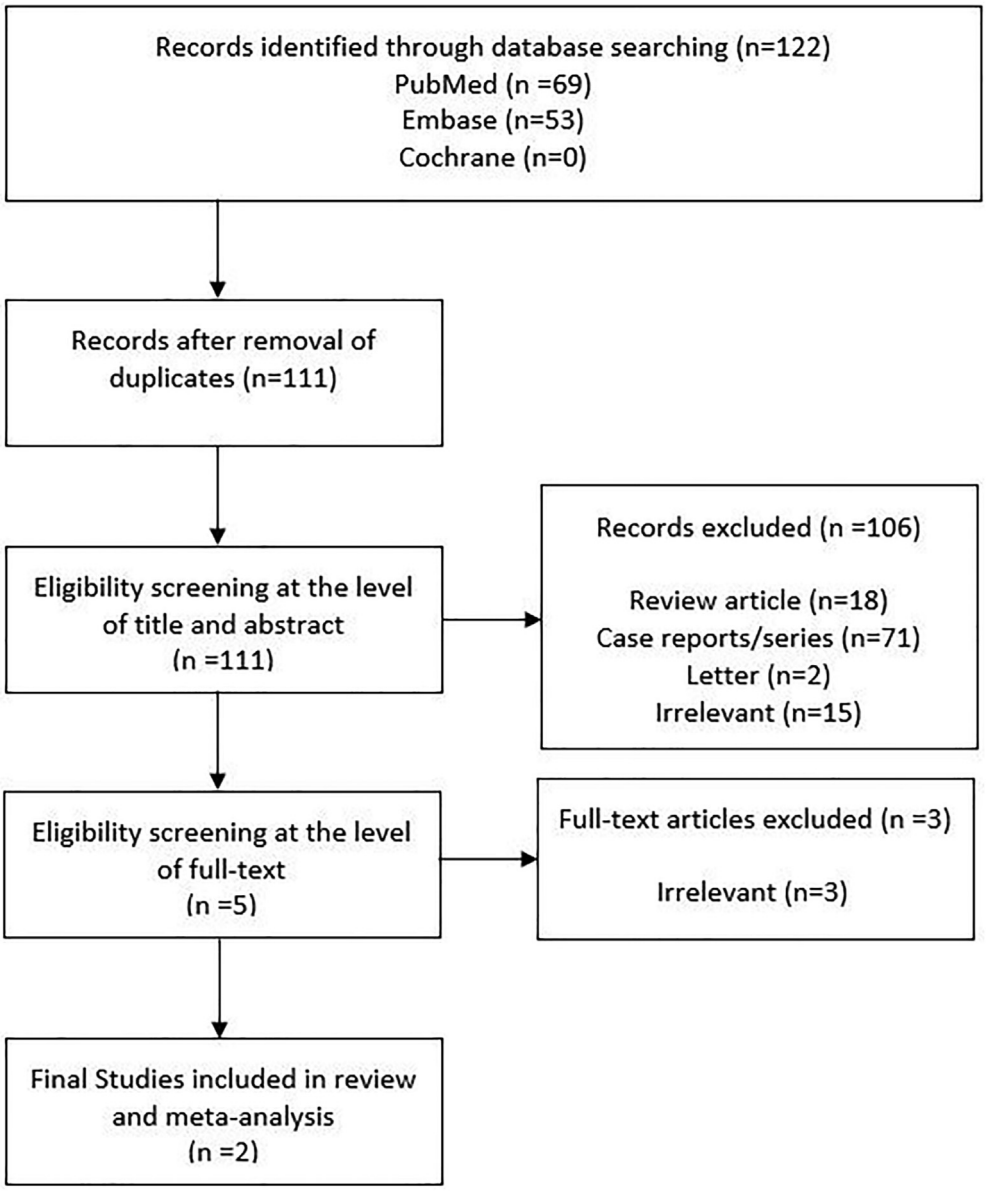

Figure 1. PRISMA flow diagram of the study.

Table 1
Characteristics of the included studies.

study	date	country	Study type	Sample size	No. of patients with toxic megacolon	Age range (mean)	Sex (female)	Underlying conditions of the patients(n)
Imbriaco et al.	2001	Italy	Descriptive	18	18	23-80 (41)	6	PMC (12) UC (4) CMV (2)
Moulin et al.	2011	France	Descriptive	16	6	35-83 (56.6)	3	UC (1) PMC (1) UC+PMC (1) None (3)

UC: Ulcerative Colitis, PMC: Pseudomembranous Colitis, CMV: Cyto Megalo Virus.

when less than five studies have been retrieved in a systematic search of the literature.[28] It should be noted that pooled prevalence rates reported in our study are rough estimates based on currently available information. Performing meta-analysis will be of greater value when further studies with larger sample sizes are available in the future.

Historically, abdominal radiography has been the most widely used imaging modality in toxic megacolon. However, studies were needed that assessed the value of CT in toxic megacolon and which sought to clarify its advantages and disadvantages when compared to abdominal radiography. To the best of our knowledge, only two studies have been published in this regard.[26,27]

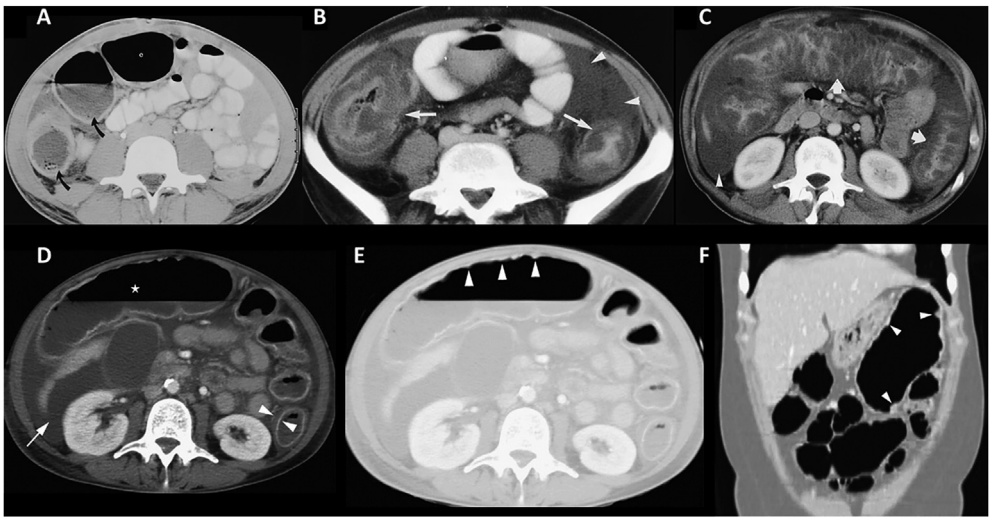

Figure 2. (A) Circumferential wall thickening (arrow) distended colon(c), (B) submucosal edema (large arrows) and ascites (arrow head), (C) accordion sign (large arrows) and ascites (arrow head), (D) left colon wall thickening with submucosal edema (arrow heads), peri colonic fat stranding and ascites (arrow), and transverse colon is dilated (star) and thinning of its wall is noted, (E), (F) abnormal haustral pattern with nodular pseudo polyps (arrow heads) a (Reproduced with permission from "Toxic megacolon: Role of CT in evaluation and detection of complications" and "Toxic megacolon in patients with severe acute colitis: computed tomographic features" by Imbriaco et al.[26] and Moulin et al.,[27] respectively).

Table 2
Reported prevalence of each CT finding along with their pooled prevalence.

CT finding	No. of Studies (n)	study	Total number of toxic megacolon patients (n)	Patients showing this finding (n)	Prevalence (%)	Pooled prevalence (%) with 95%CI	Heterogeneity		
							I^2 (%)	τ^2	p-value
Colonic distension > 6 cm	2	Imbriaco et al.	18	18	100		0	0	$p = 0.61$
		Moulin et al.	6	6	100				
Abnormal haustration	2	Imbriaco et al.	18	18	100	96 [0.75; 0.99]	0	0	$p = 0.61$
		Moulin et al.	6	6	100				
Nodular pseudo-polyps	2	Imbriaco et al.	18	13	72	76 [0.52; 0.91]	6	0.07	$p = 0.30$
		Moulin et al.	6	6	100				
Diffuse Colonic wall thickening	2	Imbriaco et al.	18	18	100		79	5.15	$p = 0.03$
		Moulin et al.	6	3	50				
Peri-colonic fat stranding	2	Imbriaco et al.	18	18	100	87 [0.29; 0.99]	67	2.84	$p = 0.08$
		Moulin et al.	6	4	66				
ascites	2	Imbriaco et al.	18	13	72	57 [0.21; 0.87]	62	0.84	$p = 0.10$
		Moulin et al.	6	2	33				
Multilayered appearance of colonic wall	2	Imbriaco et al.	18	11	61	58 [0.38; 0.76]	0	0	$p = 0.63$
		Moulin et al.	6	3	50				
Accordion Sign	1	Imbriaco et al.	18	7	39				
Pleural effusion	1	Imbriaco et al.	18	7	39				
Small bowel/gastric distension	1	Moulin et al.	6	1	16				
Segmental colonic wall thinning	1	Moulin et al.	6	6	100				

Imbriaco et al.[26] proposed that CT was a better diagnostic performance compared to abdominal radiography in the detection of complications of toxic megacolon. In 22% (4/18) of their patient population CT detected complications which were initially undetected using radiography (perforation of the colon in two patients, and "pylephlebitis with septic emboli in the superior mesenteric vein" in two other patients). They have also proposed CT having better performance compared to radiography in evaluating the "length and severity of colitis", and also in evaluating the "presence of dilatation, particularly in colonic segments filled mainly with fluid".

Imbriaco et al.[26] concluded that CT is not able to determine the underling aetiology of the toxic megacolon. However, there is another study suggesting that CT can sometimes help us determine the underling cause in a few specific cases.[4] Moulin et al.[27] concluded that CT is able to discern severe acute colitis (SAC), with and without toxic megacolon.

The most prominent limitation of our study was that only two studies were included. As toxic megacolon is a rare condition, this was not surprising that only two studies had been published in this topic

Conclusion and implications for practice

Colonic distension can be accompanied by 10 other findings in CT images of patients with toxic megacolon. Although these findings are not specific, toxic megacolon should be included in the list of differential diagnoses when these findings are present.

Conflict of interest statement

None.

Acknowledgments

None.

This research did not receive any specific grant from funding agencies in the public, commercial, or not for-profit sectors.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.radi.2020.10.019.

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