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TITLE
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YEAR
2024

DOI
10.1159/000536158

CITATION
Mäntymäki, L.-M., Grönroos, J., Aronen, A., Karvonen, J., & Ukkonen, M. (2024). Is reassessment of Computed Tomography Reports Worthwhile in Acute Diverticulitis? *Digestive Surgery, 41*(1), 37–41. Portico. https://doi.org/10.1159/000536158

VERSION
Accepted Manuscript

Research Article

Is reassessment of computed tomography reports worthwhile in acute diverticulitis?

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Short Title: reassessment of CT reports in acute diverticulitis

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Number of Tables: 3

Number of Figures: 0

Word count: 1903

Keywords: uncomplicated acute diverticulitis, complicated acute diverticulitis, computed tomography

Abstract

Introduction

Since the assessment of the disease severity in acute diverticulitis (AD) is of utmost importance to determine the optimal treatment and the need for follow-up investigations, we wanted to investigate whether the first CT report is compatible with daytime reassessment report and whether the value of initial report changes according to the experience of the radiologist.

Methods

Consecutive patients from tertiary referral center with AD were included. CT images done in the emergency department were initially analysed by either resident radiologists or consultant radiologists and then later reanalysed by consultant abdominal radiologists. Discrepancies between reports were noted.

Results

Of total of 562 patients with AD, CT images were reanalysed in 439 cases. In 22 reports (5.0%) the final report was significantly different from the initial report and management changed in 20 cases. In reports of uncomplicated acute diverticulitis (UAD) reanalysis changed initial assessment in 4.0% of the cases and in complicated acute diverticulitis (CAD) in 9.1%. When consultant and resident radiologists were compared, there was no significant difference.

Conclusion

Although no statistical difference could be noted between residents and consultants, the final report was significantly different in overall 5% of the cases when reanalysed at normal working hours by an experienced consultant abdominal radiologist. Therefore, we conclude that reassessment of CT reports is worthwhile in AD.

Introduction

Diverticular disease is a common problem which causes significant morbidity in western countries. Acute diverticulitis (AD), which is the most common complication of diverticular disease, affects 4-7% of the patients [1,2]. The incidence of AD has been rising during the past decades [3]. Because the accuracy of clinical diagnosis of acute diverticulitis (AD) is low [4], the diagnosis of AD is commonly based on radiological assessment in many institutions. Computed tomography (CT) imaging is the recommended radiological examination to diagnose AD [5] and it has high specificity and sensitivity [6,7].

The treatment of AD depends on the disease severity. Uncomplicated acute diverticulitis (UAD) can be treated conservatively even without antibiotics [8, 9] while complicated acute diverticulitis (CAD) is treated with antibiotics, operative treatment or interventional radiology**;** optimal treatment depends on the severity of the disease. It is also important to separate CAD from UAD since in CAD further colonic investigations are needed to rule out colorectal cancer (CRC). Many studies indicate that the risk for CRC is low after CT-verified UAD and advocate colonoscopy only after an episode of CAD [10, 11]. However, some studies suggest that risk for underlying cancer is significant also after UAD and the reason for it might be misdiagnosis on CT report between AD and CRC [12, 13].

Since the appropriate assessment of disease severity is of utmost importance to determine the optimal treatment and the need for follow-up investigations in AD, the accuracy of emergency department CT report is crucial. Herein, we wanted to investigate whether the first CT report in on call hours is compatible with daytime additional report by an experienced abdominal radiologist and whether the value of initial report changes according to the experience of the radiologist.

Materials and Methods

We conducted a retrospective cohort study of all patients admitted to our institution with CT-verified AD between 2015 and 2017. Approximately 250 ADs are diagnosed every year at our institution. All emergency cases within the hospital district are referred to study hospital emergency department. CT images done in the emergency department were analysed by either resident radiologists or consultant radiologists not specialized in abdominal radiology, and CT images were reanalysed by consultant abdominal radiologists. Only those CT images analysed initially by abdominal radiologists were not reanalysed later. All CT scans (GE LightSpeed CT System, GE Medical System) were performed using helical data acquisition and the data was interpreted in multiplanar (axial, coronal and sagittal) reconstructions. Intravenous contrast was used, and the scan was performed in the portal venous phase. In emergency settings, the radiologist could be consultant (experience of six

years or more) or resident (with minimum of two-year experience). Diverticulitis was classified according to classification by Ambrosetti et al [14]. Mild diverticulitis (UAD) was defined when there was thickening of the bowel wall with pericolic inflammatory oedema. Severe diverticulitis (CAD) was considered if there was perforation (extraluminal gas or contrast) or abscess. Discrepancies between **initial** and final radiological interpretations were noted. Significant difference or change was considered if the interpretation changed between the reports and if it changed the treatment. Data on patients' medical history, clinical findings and follow-up information was collected from electronic patient charts. Outcomes were followed with a median of five years after the initial AD episode.

All statistical analyses were performed using SPSS Statistics version 22 for windows. χ^2 or Fisher exact (when expected cells value was 5 or lower) tests were performed to compare categorical variables. P-value of < 0.05 was considered statistically significant.
Interobserver reliability was analyzed by performing Cohen's Kappa analysis. Values ≤ 0 indicated no agreement and 0.01–0.20 none to slight, 0.21–0.40 fair, 0.41– 0.60 moderate, 0.61–0.80 substantial, and 0.81–1.00 almost perfect agreement.

Results

A total of 562 patients were included (median age 59 [26-96] years; 63% female). Of all patients, 438 (78%) had UAD and 124 (22%) CAD. Fifty-six patients (10%) had abscess (median size 4 [2-12] cm) and six patients (1.1%) had peritonitis and only one patient (0.2%) had stricture. Of all patients 546 patients (97%) underwent nonoperative care and 16 patients (2.8%) operative care. The median follow-up time after AD was 64 (48-84) months. The baseline characteristics of the study population are shown in Table 1.

Of all patients with UAD, 87 (20%) suffered from recurrent diverticulitis, while the corresponding proportion was 30 (24%) among those with CAD. During the follow-up time three patients with complicated disease (2.4%) and one patient with uncomplicated disease (0.2%) were diagnosed with CRC. In patient with UAD, both CT reports also suspected cancer in addition to inflammation and therefore the patient underwent colonoscopy later on. One patient had complicated diverticulitis in sigmoid region and cancer in the transverse colon was detected later in colonoscopy, which was not visible in emergency CT. Two patients' initial report was changed from CAD to cancer suspicion

(preliminary report by resident and consultant). These cancers were confirmed later at operation. Outcomes during the follow-up are presented in Table 2.

In 439 cases (78%) CT images were reanalyzed by consultant abdominal radiologists. In 165 cases (38%) the initial examination was performed by consultant radiologist and in 274 cases (62%) by resident radiologist. Of those with uncomplicated disease (n=351) reanalysis changed initial assessment in 4.0% (n=14) of the cases. The corresponding proportion was 9.1% (n=8) if the disease was complicated (n=88). In 22 reports (5.0%) the final report differed from the initial report and in 20 cases the management changed due to reanalysed CT images. Further colonic investigations could be omitted in 5 cases and for 11 patient colonoscopy was recommended due to changed final report. In 5 cases where AD was found in the initial report, the additional report stated other diagnoses which required different management. Reasons for changed reports are listed in Table 3. There was no significant difference between resident and consultant radiologists. The final report was different in 5.1% of reports made by residents and in 4.8% of reports made by consultants. Cohen's kappa-values for residents and consultants were 0.95 (p<0,001) and 0.94 (p<0.001), respectively.

Discussion/Conclusion

Only few studies have been carried out concerning the reproducibility of emergency department CT reports in AD. We conducted a single center cohort study on CT findings in AD in on call hours. Overall, 22/439 (5%) reports changed significantly when CT scans were reanalyzed by a consultant abdominal radiologist. The inter-observer agreement did not vary significantly whether the report was given by resident or consultant radiologist.

AD is among the most common diagnoses in emergency departments, and the majority of these are uncomplicated. In our data 78% had UAD and 22 % had CAD. The risk of underlying CRC has been found to be low after UAD and increased after CAD [10,11]. In this study 2.4% of patients with CAD were later diagnosed with cancer. In two patients with CAD in initial report, the final report indicated suspicion of cancer which was confirmed later. Some earlier studies have reported risk of CRC to be associated with UAD as well, however the reason for it might be misdiagnosis on CT [12,13]. In the present study there was only one patient with UAD who was later diagnosed with cancer. In this case, both the initial CT report and the later report by an experienced abdominal radiologist suggested cancer possibility. Since all CRC patients in the region are treated at our institution, we can be sure that there were no additional misdiagnosed CRCs in the current study during the follow-up time.

The recommendations for further investigations after UAD and CAD are different, which emphasizes the reliability of the severity assessment made in emergency departments according to CT report [15]. In the present study, 22 reanalyzed reports differed from the initial report. Five patients could avoid unnecessary colonoscopy. It should be remembered that colonoscopy is an invasive investigation, that can cause discomfort and be potentially harmful to the patient. In cases which the initial report was changed from UAD to CAD (n=11), patients were guided to further colonoscopy, since the risk of CRC is high after CAD [10,11].

In the present study, there was no statistical difference whether the initial report was made by resident or consultant radiologist when compared to the final report. The initial report changed in 5% of all reanalyzed reports. Peery et al. [16] showed similar findings in CT examinations made because abdominal pain. In their study the reports made in normal working hours had higher strength of agreement than CTs reported out of hours but there was no significant difference in overall accuracy, and reporter seniority was not associated with improved diagnostic accuracy. Van Randen et al. [17] reported that inter-observer agreement was excellent in unselected patients with abdominal pain and especially in AD, in which the median kappa value was 0. 9, when three radiologists independently examined CT reports. In their study the CT reports were reviewed by experienced radiologists. Our study showed similar inter-observer findings, Cohen's kappa-values for residents and consultants were 0.95 and 0.94, respectively.

This study has some potential limitations. This was a retrospective single center cohort study. We could not evaluate the inter-observer agreement between individual radiologists with varying experience. Due to wide spectrum of individual radiologists, the inter-observer agreement was measured between all residents and all consultants. All radiologists had a minimum of two-year experience in analyzing CT scans. Nevertheless, this reflects well the normal clinical practice. Another potential limitation of the study is that AD was not confirmed later with colonoscopy or at surgery in the majority of the patients. However, the median follow-up time was five years after the initial emergency department admission. We trust that cancers should have been diagnosed during this follow-up time. Follow-up data on our patients was comprehensive and all later emergency admissions were included as well.

Although no statistical difference could be noted between residents and consultants, the final CT report was different in one in twenty of the cases with AD when reanalysed at normal working hours by an experienced consultant abdominal radiologist. The management changed in 20 cases substantially. In conclusion, reassessment of CT reports given in on call hours is worthwhile in AD.

Statements

Acknowledgement

We would like to thank Niklas Ånäs, M.D., (Tampere University Hospital) for valuable assistance in clarifying the CT protocol used in the study hospital.

Statement of Ethics

The study protocol was approved by the Regional Ethics Committee of the Expert Responsibility Area of Tampere University Hospital (permission number R21587). The study was conducted according to the requirements of the Helsinki Declaration. In compliance with the principles of the local ethics committee, exemption from consent was obtained as the data had already been collected for clinical purposes.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Funding Sources

No funding was received for the submitted work.

Author Contributions

L-MM contributed to the study design and literature search, participated in data collection, data interpretation and wrote the manuscript. AA participated in data collection and critical revision of the manuscript. JG and JK participated in study design and critical revision of the manuscript. MU participated in study design, data collection and interpretation and did the statistical analysis and critical revision of the manuscript.

Data Availability Statement

Research data are not publicly available on legal grounds. Further enquiries can be directed to the corresponding author

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Table 1. Baseline characteristics (n=562)

Variable	
Age, median (min-max)	59 (26–96) years
Sex, female	356 (63%)
UAD	438 (78%)
CAD	124 (22%)
Abscess	56 (10%)
Abscess size, median (min-max)	4 (2-12) cm
Peritonitis	6 (1.1%)
Stricture	1 (0.2%)
Nonoperative treatment	546 (97%)
Operative treatment	16 (2.8%)
Earlier AD	143 (25%)

UAD = uncomplicated acute diverticulitis

CAD = complicated acute diverticulitis

AD = acute diverticulitis

Table 2. Outcomes during the median follow-up of five years

	CAD	**UAD**
	n=124	n=438
Recurrent diverticulitis	30 (24%)	87 (20%)
Cancer	3 (2.4%)	1 (0.2%)

CAD = complicated acute diverticulitis

UAD = uncomplicated acute diverticulitis

Table 3. The reasons for changed reports

	Resident n=14	Consultant n=8
UAD → CAD	4 (29 %)	3 (38%)
UAD → additional diagnosis[1]	2 (14%)	0 (0%)
UAD → other diagnosis[2]	3 (21%)	0 (0%)
CAD → UAD	3 (21%)	2 (25%)
CAD → perforation (Not AD)	0 (0%)	1 (13%)
CAD → cancer suspicion	1 (7%)	1 (13%)
Unspecific findings → UAD	0 (0%)	1 (13%)
Epiploic appendagitis → CAD	1 (7%)	0 (0%)

UAD = uncomplicated acute diverticulitis

CAD = complicated acute diverticulitis

[1] suspicion of cancer in addition to UAD (cancer was not found in colonoscopy)

[2] colitis