Comparison of diagnostic performance of CT with rectal contrast vs. CT with rectal and intravenous contrast for the diagnosis of acute appendicitis

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Abstract

Aim: *Computed tomography (CT) is an essential investigation for the evaluation of suspected acute appendicitis (AA) owing to its high accuracy and the ability to provide an alternate diagnosis, however, there is still debate on the optimal CT technique with protocols varying between institutions. The present study aimed to compare the diagnostic accuracy of CT with rectal contrast (CT-RC) with that of CT with both rectal and intravenous contrast (CT-IVRC) in the diagnosis of AA.*

Material and methods: *CTs of 135 patients were analysed by 2 radiologists retrospectively. Clinical outcome was used as the final diagnosis. The diagnostic accuracy of each CT technique was calculated and compared with each other.*

Results: *There was strong agreement inter and intra-observer agreement for the diagnosis of AA (kappa= 0.76, 0.87, 0.89 and 0.91 for CT-RC and CT-IVRC, respectively). The sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of CT-RC and CT-IVRC for the diagnosis of AA were not statistically different from each other (p-value>0.05 for all comparisons). The accuracy of two CT protocols in diagnosing AA ranged from 82% to 88%. The area under the curves (AUC) for diagnosing AA on CT-RC and CT-IVRC for two observers were 0.87. 0.9, 0.89 and 0.91 respectively.*

Conclusions: *CT-RC proved to be as accurate as CT-IVRC in the diagnosis of AA. CT with rectal contrast alone could be performed in suspected cases of AA particularly in patients with contraindications to intravenous contrast administration.*

Keywords: *Acute appendicitis; imaging; radiation; iodine contrast; diagnostic performance*

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Introduction

Acute appendicitis (AA) constitutes one of the important causes of abdominal pain and is a frequent reason for emergency department (ED) visits. AA is the most common cause of hospitalization in young patients presenting with acute abdomen (1). AA has an estimated annual occurrence of 5.7–50 per 100,000 population per year with a peak incidence between the age of 10 -30 years (1).

The clinical data and laboratory information may not be always sufficient to diagnose or exclude AA or to provide an alternative diagnosis. Although appendectomy has been the standard of care for the management of AA, recently there has been a gradual shift towards conservative management of AA (2-3). However, before a firm management decision is made it is essential to establish a confident diagnosis of AA. Imaging comprising of ultrasonography (US), computed tomography (CT), and magnetic resonance imaging (MRI) all can be used to clinch the diagnosis of AA (3). US is the preliminary diagnostic tool (4). However, abdominal CT has superseded US for the evaluation of suspected AA in most centres owing to its high accuracy and the ability to provide an alternate diagnosis in non-appendicitis patients (5). It has been observed that CT

decreases the negative appendectomy rates without increasing the rate of AA-related complications like perforation or peritonitis (6). MRI is reserved for specific clinical scenarios where the US may be unable to provide a diagnosis and CT is contraindicated like in pregnancy (7, 8).

The debate for the selection of optimal CT technique in the evaluation of suspected AA is still unresolved and different centres opt for different protocols (5). CT with administration of both intravenous (IV) and positive oral contrast has been the traditional technique with arguably the highest diagnostic yield (5, 9). The widespread use of this technique was based on the premise that this is the standard body imaging technique capable of maximising the visualisation of the appendix and allowing for the identification of extra-appendiceal pathologies (5). Despite its remarkably high accuracy for diagnosing AA, this technique is not necessarily the optimal or safest technique. Administration of IV contrast is fraught with many potential risks including the risk of anaphylactic reactions, risk of contrast-induced nephropathy (CIN), potential risk of extravasation and increased cost (10). The use of positive oral contrast is associated with time delays as it requires the passage of contrast to the caecum (11). The alternative protocols used by different centres across the world include IV contrast alone, positive oral contrast alone, rectal contrast alone, both IV and rectal contrast and no use of contrast (12-17).

The use of positive oral contrast and rectal contrast can aid in the easy detection of the appendix when the caecum and terminal ileum are opacified with contrast and secondly, filling of the lumen of an appendix with contrast essentially rules out appendicitis (5). Positive oral contrast is associated with a time delay of approximately 1-2 hours which is the usual transit time and secondly, in 18-30% of patients the contrast fails to reach the caecum (5). Additionally, oral contrast will not be tolerated by patients with nausea or vomiting. Rectal contrast is associated with shorter delays of around 20 minutes and acceptable levels of patient discomfort (18). The use of rectal contrast-enhanced CT (CT-RC) has been studied in isolation and has been found useful with a sensitivity of 98% and a diagnostic accuracy of 98% (19). However, a direct comparison between CT-RC and rectal contrast plus IV contrast-enhanced CT (CT-IVRC) is lacking. The purpose of this study was to compare the diagnostic accuracy of CT-RC with that of CT-IVRC in the diagnosis of AA.

Methods

Study design and patient cohort

This was a single-centre retrospective cross-sectional analytical study conducted for a period of one year, between January 2020 to December 2020. The study was approved by the institutional research committee. Due to the retrospective nature of the study, the requirement for patient consent was waived.

One hundred thirty-five patients who presented to ED with abdominal pain with a clinical suspicion of AA and underwent abdominal CT with both rectal and IV contrast were retrospectively enrolled in the study. Abdominal CT was performed after administration of rectal contrast followed by a second scan after administration of IV contrast according to the departmental protocol. Patients who had only rectal or IV-enhanced scans were excluded. The final diagnosis of AA was confirmed by surgery/histopathology or conservative management with follow-up for more than 2 months.

We searched our electronic database for cases of non-traumatic acute right lower quadrant or lower abdominal pain who reported to ED and underwent abdominal CT with a clinical suspicion of AA in the year 2020. Radiological, clinical, surgical, pathological and follow-up data were collected and analysed retrospectively.

Among the entire cohort of 135 patients, 56 patients received a final diagnosis of AA. Taking surgery or conservative management for AA as the reference standard we evaluated the diagnostic accuracy of CT-RC and compared it with that of combined CT-IVRC.

Data collection

CT acquisition protocol and image interpretation

All CT scans were performed on 64-slice Multidetector CT. All patients underwent a CT-RC first. Rectal contrast was administered in the left lateral position using a rectal tube and 1-1.5 litre of normal saline mixed with 20-30ml of iodinated contrast. From the initial left lateral position patients were rolled into a supine and then right lateral position to allow the passage of contrast into the caecum. After 20 minutes first scan was acquired in a single breath-hold after setting up the patient in a head-first supine position in the CT gantry. The following scanning parameters were used: slice thickness 1-1.5 mm, tube voltage 100-120 kVp, tube current of 90-130mAs and a beam pitch of 1.5. The tube current was regulated by an automatic exposure control system. Images were reconstructed using a recons-

truction increment of 0.7mm into a slice thickness of 1 mm. Using the same position and parameters a second scan was obtained after IV contrast administration in the portal venous phase.

To avoid any bias the CT scans were anonymised by a third radiologist (B.A) who was not involved in reading the images and then presented to the interpreting radiologists. Each patient had two sets of images including CT-RC and CT-IVRC. The CT images were analysed independently by two radiologists, one consultant and another resident with 15 and 4 years of experience, respectively, who were blinded to the clinical and outcome data.

The CTs were analysed for the following characteristics:

1. Visualization or non-visualization of an appendix
2. Fluid-filled or air-filled appendiceal lumen
3. maximum outer diameter of an appendix
4. presence of fecolith in the lumen of appendix
5. presence of peri-appendiceal fat stranding
6. enlarged surrounding nodes
7. presence of peri-appendiceal free fluid or collection
8. presence of extra-luminal air.

Appendicitis was defined according to the established criteria of maximal outer diameter >6mm with surrounding inflammation like peri-appendiceal fat stranding or fluid with a non-opacified lumen (20).

Statistical analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSSInc. Chicago, IL, version 21.0). Continuous variables were expressed as means and standard deviations. Categorical variables were expressed as counts and percentages. Fisher's exact test was used to examine the categorical variables. Two sample student t-tests was used for the comparison of continuous variables when the data was normally distributed, while the Mann-Whitney U test was used when the data was not normally distributed. A p-value less than 0.05 was considered statistically significant. Cohen's kappa was used to determine inter-observer reliability for reading CT images.

Results

135 patients were enrolled into the study comprising 69 (51%) male and 66 (49%) female patients. The mean age of the study population was 32.26±11.73 years. Based on surgery/histopathology or conservative management 56 (41.5%) patients received a final diagnosis of AA and the remaining 79 (58.5%) were found to have an alternate diagnosis. Among the baseline characteristics only WBC counts and CRP levels were significantly higher in the AA group compared to the non-AA group (Table 1).

Computed tomography findings of acute appendicitis

Various CT findings were correlated between the AA and non-AA groups. The appendix diameter was significantly higher in AA patients compared to non-AA patients (10 mm vs 5.2 mm) (p-value <0.001). Similarly, wall thickening, peri-appendiceal stranding, peri-appendiceal nodes, peri-appendiceal fluid, presence of appendicolith and wall interruption had a statistically significant association with a diagnosis of AA, whereas the presence of intraluminal contrast or intraluminal air and absence of abnormal wall enhancement were negative predictors of AA on both CT-RC and CT-IVRC (all p-values <0.05) (Table 2 and 3) (Figs. 1-5).

Agreement between the two observers for various parameters on CT-RC and CT-IVRC:

A consultant and a radiology resident were the interpreters. There was good agreement (k= 0.76) between the two readers in diagnosing AA on CT-RC (Table 2). However, there was almost perfect agreement (k= 0.87) between the two readers in diagnosing AA on CT-IVRC (Table 3).

For individual parameters, the level of agreement was moderate (kappa= 0.41 – 0.60) between the two observers in interpreting some parameters like wall thickening, intraluminal contrast, or intraluminal air, peri-appendiceal nodes and peri-appendiceal fluid and good to very good agreement (k > 0.60) in interpreting other parameters (peri-appendiceal stranding and appendicolith) on CT-RC. However, the level of agreement increased marginally between the two observers on CT-IVRC for various individual parameters (good agreement (k>0.60) for all the parameters except periappendiceal lymph nodes) (Table 3). Observer 1 was able to provide a diagnosis in all cases on both CT-RC and CT-IVRC, whereas Observer 2 was not able to provide any diagnosis in two cases on both CT-RC and CT-IVRC.

Intra-observer agreement for both readers:

The intra-observer agreement for various parameters for both observers is given in Table 4. The level of agreement was marginally better for both the observers on CT-IVRC.

Comparison of diagnostic performance of two CT protocols in detecting acute appendicitis:
The receiver operator characteristic (ROC) curve showed that the area under the curve (AUC) for diagnosing AA on CT-RC for two observers was 0.87 and 0.9, respectively. The AUC for diagnosing AA on CT-IVRC for two observers was 089 and 0.91, respectively (Table 5). The sensitivity, specificity, PPV, NPV and diagnostic accuracy of CT-RC were not significantly different between CT-IVRC and CT-RC for both observers (Table 5).

Discussion

CT is a sensitive and specific imaging tool for diagnosing AA, with pooled sensitivity and specificity of 96% and 92% (1). The use of CT in this clinical setting has been shown to decrease negative laparotomy rates and improve patient care (6). Despite its widespread use, there is still no firm consensus over the optimal CT technique for the diagnosis of AA. So, different institutions follow different CT protocols. CT with IV, oral contrast, rectal contrast and non-contrast CT are all employed for the diagnosis of AA (10). Non-contrast CT can be performed rapidly without the attendant risks and discomfort of contrast, but it may fail to detect AA in some cases especially when the reader is inexperienced.
IV contrast administration entails the risks of allergic reactions and CIN. CT with oral contrast is time-consuming, may lead to diagnostic delay and may not be feasible in patients with nausea and vomiting. CT-RC which can be performed rapidly is free from potential allergic reactions associated with IV contrast administration, and, therefore, may be the preferred initial technique in the diagnostic workup of suspected AA (12).

The present study demonstrated that the two CT protocols employing only CT-RC and CT-IVRC had comparable diagnostic accuracy for the diagnosis of AA. The AUC for both protocols was around 0.90 for both observers. The major advantage of the current study was that it provided a direct comparison between CT-RC and CT-IVRC. In contrast to previous studies (15-19), no difference was found in the ability (diagnostic accuracy, sensitivity, specificity, PPV, or NPV) to identify patients with AA. Similarly, they did not differ significantly in their ability to provide an alternative diagnosis in non-appendicitis patients.
CT-RC is equally accurate, although less sensitive, compared to combined CT with oral and IV contrast and significantly superior to non-contrast CT for the diagnosis of AA (15). S. Walker et.al in a study using CT-RC obtained a sensitivity of 94%, specificity of 100%, and accuracy of 96%, in diagnosing AA (16).
Mittal V.K et.al performed a randomized controlled trial to compare the accuracy of CT-RC alone with a triple contrast CT (oral, rectal, and IV contrast administration) and concluded that CT-RC had a comparable diagnostic performance and was better tolerated by patients, financially cheaper and reduced the time to diagnosis and negative appendectomy rate with no missed diagnosis (20).
Our results reiterate that CT-RC has several advantages. It is less time-consuming, tolerated well by patients with no potential hazards of IV or oral contrast and has a comparable diagnostic accuracy. Additionally, the diagnostic accuracy was almost similar for both experienced and relatively inexperienced radiologists.
However, retrospective design, single centre and small sample size are some important limitations of the study.

Conclusion

CT-RC has a comparable diagnostic performance compared to CT-IVRC in the detection of AA. CT-RC could be performed in suspected cases of AA particularly where there is a contraindication to IV contrast administration or if there is a risk of developing a severe adverse reaction.

Figures:

Fig.1

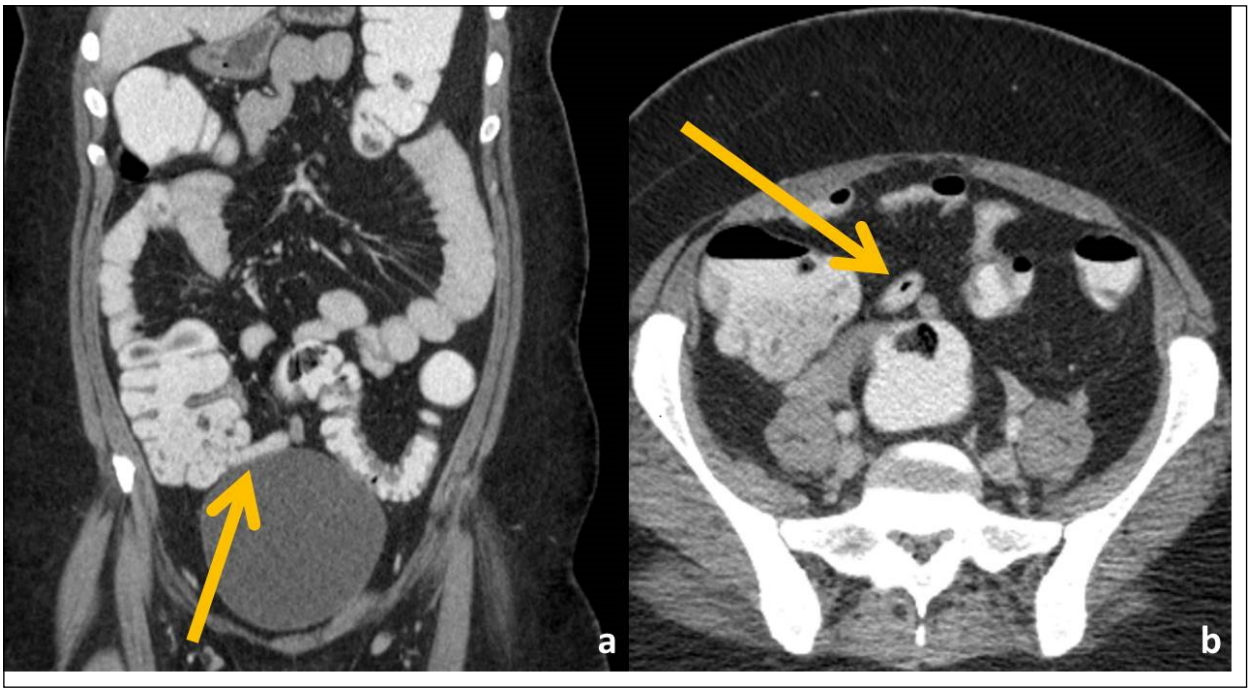


Fig.2

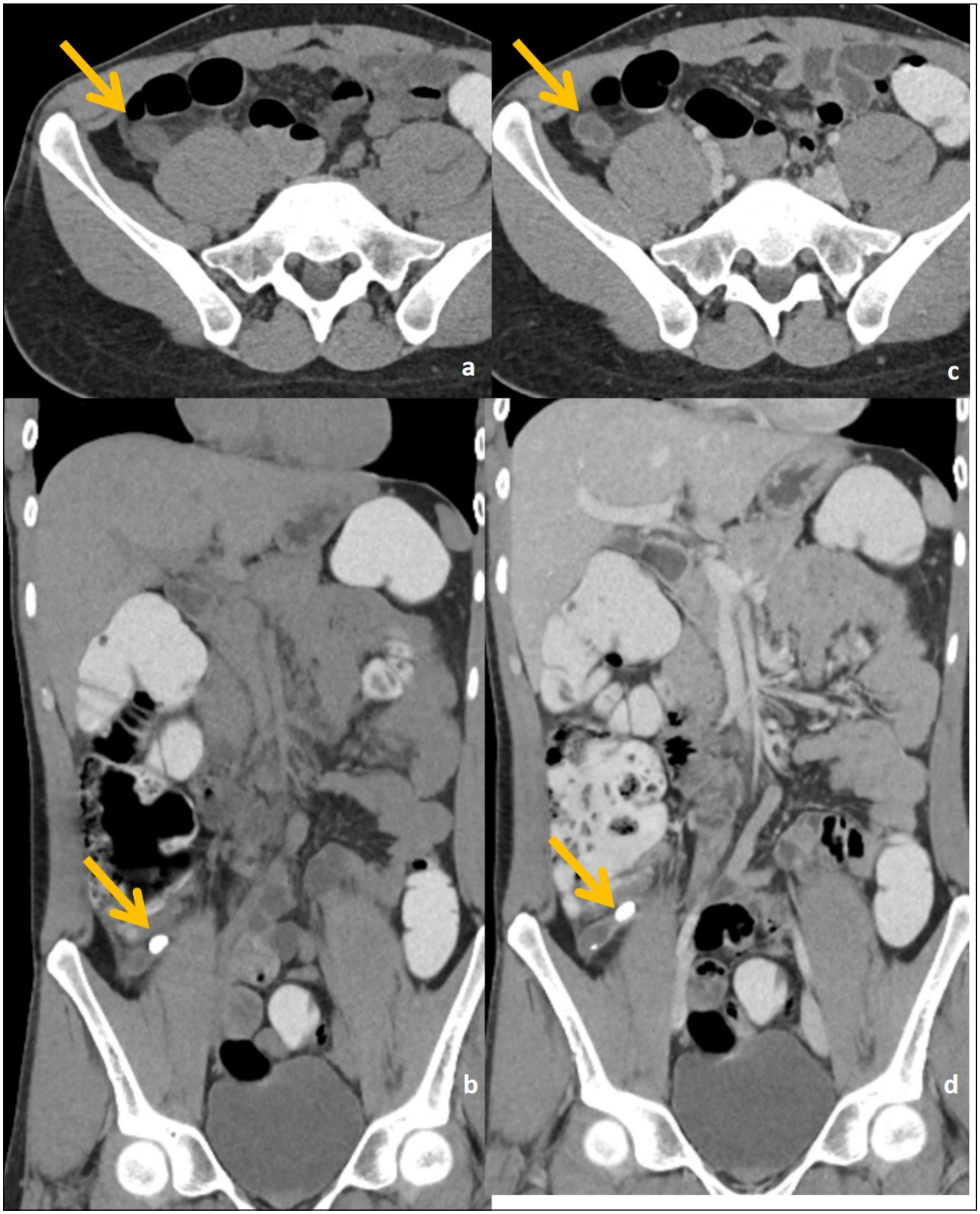


Fig. 3

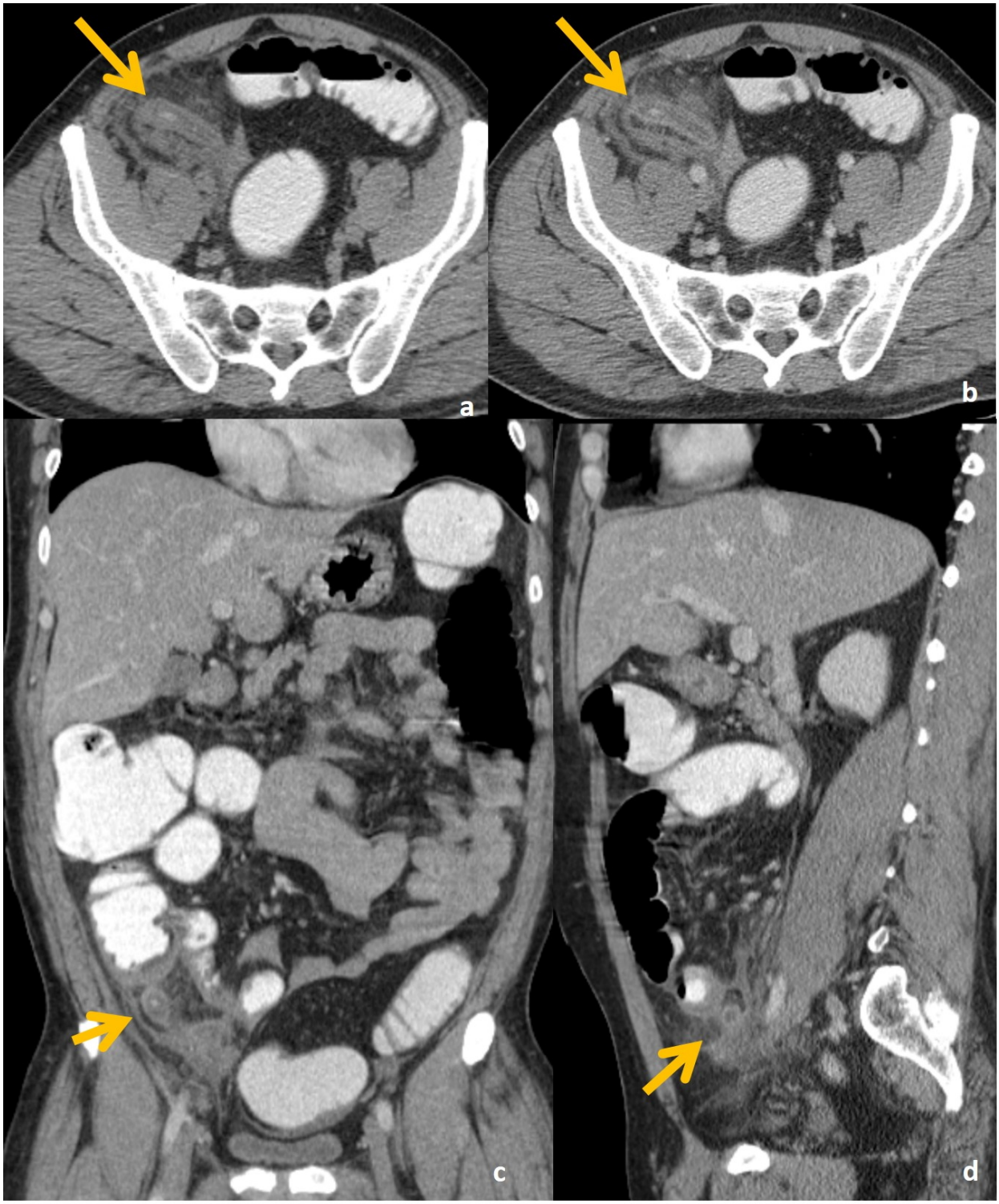


Fig. 4

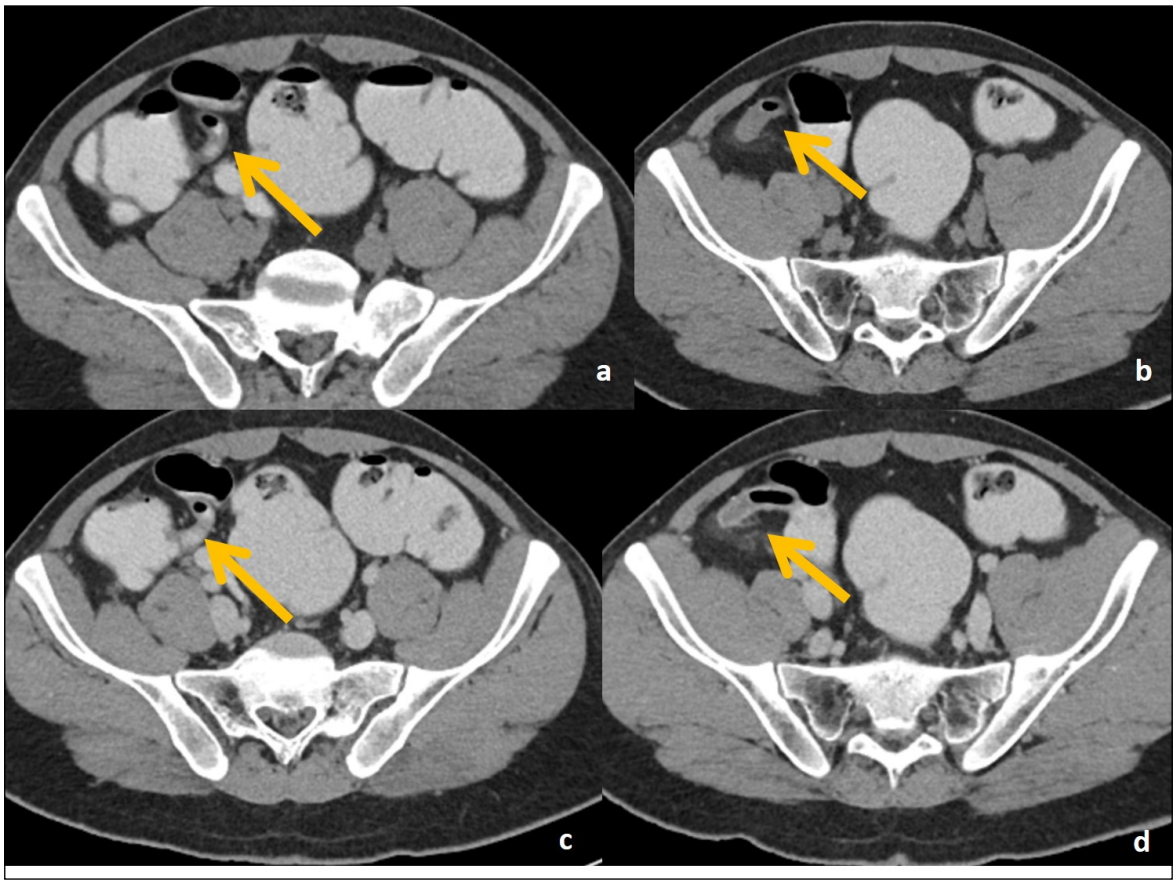
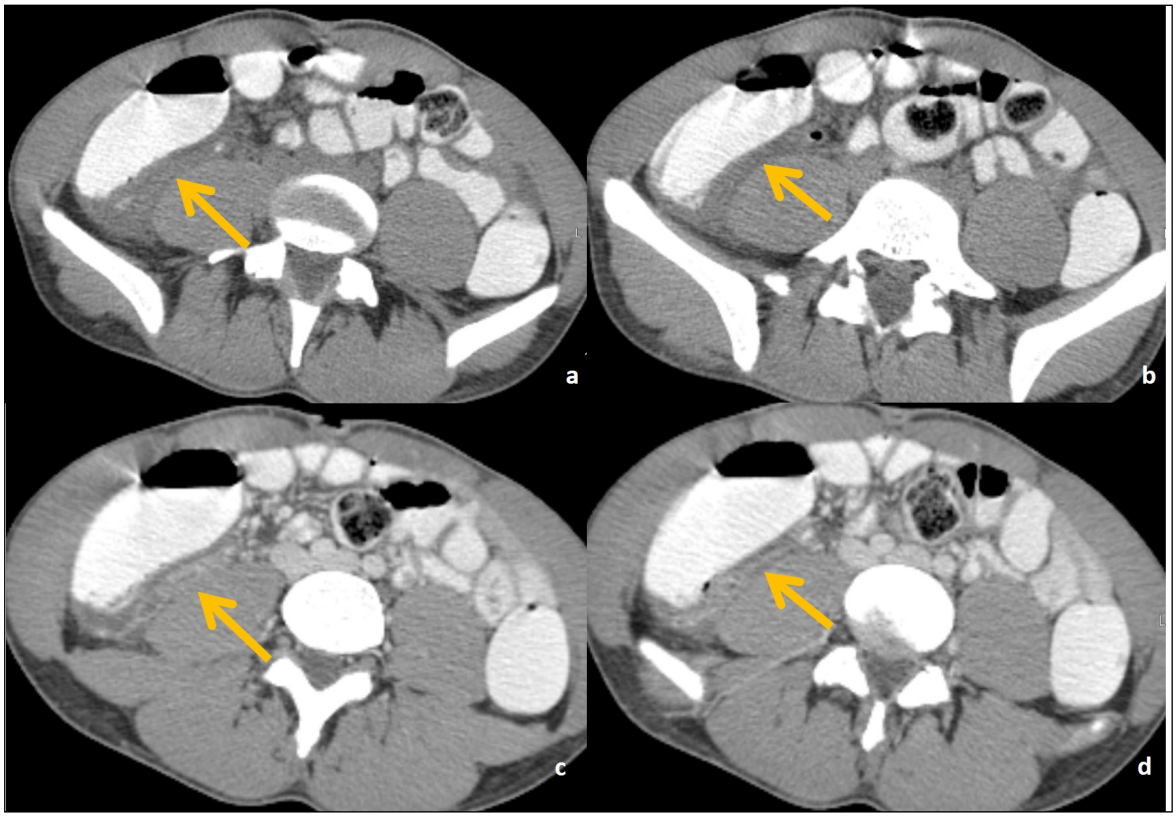


Fig. 5



Tables:

Table 1 Demographic and clinical data

	Acute appendicitis (n=56)	Non-appendicitis group (n=79)	P value
Age	33 (19-91)	30 (19-61)	0.192[a]
BMI	27.25 ± 6.1	28.81 ± 7.78	0.340[b]
CRP	24 (50-463.4)	10 (10-235.5)	0.003[a]
WBC	9.65 (4.33-18.77)	8.49 (3.59-19.22)	0.009[a]
Gender (Female / Male)	20 / 36	46 / 33	0.014[c]
Diameter OB1 (CT-RC)	10 (3.5-20)	5.2 (2.4-29)	< 0.001[a]
Diameter OB2 (CT-RC)	10 (4.8-20)	5 (2-25)	< 0.001 [a]
Diameter OB1 (CT-IVRC)	10 (3-21)	4.5 (1.8-28.5)	< 0.001 [a]
Diameter OB2 (CT-IVRC)	10 (4-8)	5 (2-28)	< 0.001 [a]

[a] *Mann Whitney U Test (variables are presented as median [range]),*

[b] *Student T-Test (variables are presented as mean ± SD).*

[c] *Fisher's Exact Test*

***Abbreviations**: n: number, BMI: Body mass index, CRP: C-reactive protein, WBC: white blood cell, OB: observer, CT-RC: computed tomography with rectal contrast, CT-IVRC: computed tomography with intravenous and rectal contrast.*

Table 2 Comparison of data obtained from CT-RC by observers

		Observer 1 [n, (%)]			Observer 2 [n, (%)]			Repeatability Analysis[a]	
		Acute appendicitis	Non-appendicitis group	p*	Acute appendicitis	Non-appendicitis group	p*	kappa	P**
Wall thickening	**Present**	43 (76.8)	9 (11.4)	< 0.001	43 (76.8)	7 (8.9)	< 0.001	0.598	< 0.001
	Absent	13 (23.2)	70 (88.6)		13 (23.2)	70 (88.6)			
	N/A	-	-			2 (1.2)			
Intraluminal contrast	**Present**	5 (8.9)	52 (65.8)	< 0.001	9 (16.1)	63 (79.7)	< 0.001	0.582	< 0.001
	Absent	51 (91.1)	27 (34.2)		47 (83.9)	14 (17.7)			
	N/A					2 (2.5)			
Intraluminal air	**Present**	8 (14.3)	47 (59.5)	< 0.001	9 (16.1)	59 (74.7)	< 0.001	0.549	< 0.001
	Absent	48 (85.7)	32 (40.5)		47 (83.9)	18 (22.8)			
	N/A	-	-		-	2 (2.5)			
Periappendiceal LN	**Present**	44 (78.6)	15 (19)	< 0.001	45 (80.4)	31 (29.2)	< 0.001	0.402	< 0.001
	Absent	12 (21.4)	64 (81)		11 (19.6)	48 (60.8)			
	N/A	-	-						
Appendicolith	**Present**	16 (28.6)	1 (1.3)	< 0.001	13 (23.2)	1 (1.3)	< 0.001	0.818	< 0.001
	Absent	40 (71.4)	78 (98.7)		43 (76.8)	78 (98.7)			
	N/A								
Periappendiceal fat stranding	**Present**	49 (87.5)	12 (15.2)	< 0.001	44 (78.6)	11 (13.9)	< 0.001	0.776	< 0.001
	Absent	7 (12.5)	67 (84.8)		12 (21.4)	67 (84.8)			
	N/A					1 (1.3)			
Periappendiceal fluid	**Present**	9 (16.1)	2 (2.5)	0.008	23 (41.1)	2 (2.5)	< 0.001	0.422	< 0.001
	Absent	47 (83.9)	77 (97.5)		33 (58.9)	76 (96.2)			
	N/A					1 (1.3)			
Wall interruption	**Present**	10 (17.9)	3 (3.8)	0.008	7 (12.5)	1 (1.3)	0.007	0.389	< 0.001
	Absent	46 (82.1)	76 (96.2)		49 (87.5)	76 (96.2)			
	N/A					2 (1.3)			
Pericecal inflammation	**Present**	28 (50)	11 (13.9)	< 0.001	21 (37.5)	11 (13.9)	0.002	0.752	< 0.001
	Absent	28 (50)	68 (86.1)		35 (62.5)	68 (86.1)			
	N/A					-			
Pericecal/ appendical collection	**Present**	8 (14.3)	9 (11.4)	0.611	5 (8.9)	5 (6.3)	0.741	0.469	< 0.001
	Absent	48 (85.7)	70 (88.6)		51 (91.1)	74 (93.7)			
	N/A								
Diagnosis	**A. appendicitis**	49 (87.5)	7 (8.9)	<0.001	46(82.1)	8 (10.1)		0.759	0.01
	Non appendicitis	7 (12.5)	72(91.1)		10 (17.9)	69 (87.3)	< 0.001		
	Not sure					2 (2.6)			

**Fischer's Exact test*
***p value for reliability*
Repeatability Analysis[a]: Kappa analysis between observers
Abbreviations: CT-RC: computed tomography with rectal contrast, n: number, N/A: non-applicable.

Table 3 Comparison of data obtained from CT IVRC by observers

		Observer 1 [n, (%)]			Observer 2 [n, (%)]			Repeatability Analysis[a]	
		Acute appendicitis	Non-appendicitis group	p*	Acute appendicitis	Non-appendicitis group	p*	kappa	P**
Wall thickening	Present	48 (85.7)	15 (19)	< 0.001	48 (76.8)	6 (7.6)	< 0.001	0.660	0.036
	Absent	8 (14.3)	64 (84)		8 (23.2)	71 (89.9)			
	N/A	-	-			2 (2.5)			
Wall enhancement	Present	47 (83.9)	14 (17.7)	< 0.001	50 (89.3)	10 (12.7)	< 0.001	0.750	0.022
	Absent	9 (16.1)	65 (82.3)		6 (10.7)	67 (84.8)			
	N/A					2 (2.5)			
Intraluminal contrast	Present	7 (12.5)	60 (75.9)	< 0.001	8 (14.3)	64 (81)	< 0.001	0.694	0.010
	Absent	49 (87.5)	19 (24.1)		48 (85.7)	13 (16.5)			
	N/A					2 (2.5)			
Intraluminal air	Present	4 (7.1)	50 (63.3)	< 0.001	8 (14.3)	57 (72.2)	< 0.001	0.692	< 0.001
	Absent	52 (92.9)	29 (32.7)		48 (85.7)	20 (25.3)			
	N/A	-	-		-	2 (2.5)			
Periappendiceal LN	Present	48 (85.7)	15 (19)	< 0.001	47 (83.9)	35 (44.3)	< 0.001	0.401	< 0.001
	Absent	8 (14.3)	64 (81)		9 (16.1)	44 (55.7)			
	N/A	-	-						
Appendicolith	Present	18 (32.1)	2 (2.5)	< 0.001	13 (23.2)	1 (1.3)	< 0.001	0.732	< 0.001
	Absent	38 (67.9)	77 (97.5)		43 (76.8)	78 (98.7)			
	N/A								
Periappendiceal fat stranding	Present	46 (82.1)	13 (16.5)	< 0.001	44 (78.6)	9 (11.4)	< 0.001	0.774	0.038
	Absent	10 (17.9)	66 (83.5)		12 (21.4)	69 (87.3)			
	N/A					1 (1.3)			
Periappendiceal fluid	Present	18 (32.1)	3 (3.8)	<0.001	23 (41.1)	4 (5.1)	< 0.001	0.697	< 0.001
	Absent	38 (67.9)	76 (96.2)		33 (58.9)	75 (94.9)			
	N/A								
Wall interruption	Present	14 (25)	2 (2.5)	< 0.001	7 (12.5)	1 (1.3)	0.007	0.497	< 0.001
	Absent	42 (75)	77 (97.5)		49 (87.5)	76 (96.2)			
	N/A					2 (1.3)			
Pericecal inflammation	Present	25 (44.6)	11 (13.9)	< 0.001	13 (23.2)	10 (12.7)	0.162	0.593	< 0.001
	Absent	31 (55.4)	68 (86.1)		43 (76.8)	69 (87.3)			
	N/A					-			
Pericecal/appendical collection	Present	8 (14.3)	7 (8.9)	0.407	4 (7.1)	4 (5.1)	0.718	0.387	< 0.001
	Absent	48 (85.7)	72 (91.1)		52 (92.9)	75 (94.9)			
	N/A								
Diagnosis	A.appendicitis	47 (83.9)	8 (10.1)	<0.001	50(89.3)	8 (10.1)	< 0.001	0.866	0.016
	Non appendicitis	9(16.1)	71 (90.9)		6 (10.7)	69 (87.3)			
	Not sure					2 (2.6)			

**Fischer's Exact test*

***p value for reliability*

Repeatability Analysisa: Kappa analysis between observers

Abbreviations: CT-IVRC: computed tomography with intravenous and rectal contrast, n: number, N/A: non-applicable.

Table 4 Intraobserver analysis (data from the same observer obtained from CT-RC and CT-IVRC were used)

	OBSERVER 1		OBSERVER 2	
	Kappa values	p	Kappa values	p
CT-RC diagnosis vs final diagnosis	0.740	< 0.001	0.699	< 0.001
CT-IVRC diagnosis vs final diagnosis	0.786	< 0.001	0.761	< 0.001
Diagnosis (CT-RC vs CT-IVRC)	0.893	< 0.001	0.912	< 0.001
Appendix diameter (mm)	0.967 (0.953-0.976)*	< 0.001	0.982 (0.975-0.987)	< 0.001
Wall thickening	0.624	< 0.001	0.849	< 0.001
Luminal contrast	0.703	< 0.001	0.797	< 0.001
Luminal air	0.769	< 0.001	0.899	< 0.001
Periappendical LN	0.880	< 0.001	0.909	< 0.001
Appendicolith	0.718	< 0.001	0.841	< 0.001
Periapendical fat stranding	0.760	< 0.001	0.909	< 0.001
Periappendical free fluid	0.580	< 0.001	0.790	< 0.001
Wall interruption	0.653	< 0.001	0.787	< 0.001
Pericecal inflammation	0.760	< 0.001	0.751	< 0.001
Periapendicocecal collection	0.787	< 0.001	0.643	< 0.001

** ICC (95% CI) (two way mixed absolute agreement, multiple measures)*

Abbreviations: CT-RC: computed tomography with rectal contrast, CT-IVRC: computed tomography with intravenous and rectal contrast, mm; millimeter, LN: lymph node.

Table 5 Comparison of diagnostic performance of two CT techniques in detecting acute appendicitis

	CT-RC		CT -IVRC	
	Observer 1	Observer 2	Observer 1	Observer 2
AUC (95% CI)	0.872 (0.808-936)	0.918 (0.870-0.967)	0.898 (0.841-0.955)	0.912 (0.859-0.965)
Sensitivity	91.1	94.6	92.9	94.6
Specificity	73.4	78.5	78.5	82.3
PPV (95% CI)	77.40 (75.52-79.18)	81.48 (79.61 -83.22)	81.21 (79.31-82.96)	84.24 (82.37-85.94)
NPV (95% CI)	89.19 (87.08-90.98)	93.56 (91.8-94.97)	91.71 (89.81-93.27)	93.84 (92.15-95.19)
Accuracy (95% CI)	82.25 (80.5-83.9)	86.55 (84.98-88.02)	85.7 (84.09-84.21)	88.45 (86.97-89.32)

Abbreviations: CT-RC: computed tomography with rectal contrast, CT-IVRC: computed tomography with intravenous and rectal contrast, AUC: area under curve, PPV: positive predictive value, CI: confidence interval, NPV: negative predictive value.

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Declarations

Consent for publication: The author clarifies that written informed consent was obtained and the anonymity of the patient was ensured. This study submitted to Swiss J. Rad. Nucl. Med. has been conducted in accordance with the Declaration of Helsinki and according to requirements of all applicable local and international standards. All authors contributed to the conception and design of the manuscript, participated in drafting and revising the content critically for important intellectual input, and approved the final version for publication. Each author agrees to be accountable for all aspects of the work, ensuring its accuracy and integrity.
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