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Evaluation of Colonic Wall Thickness in Ulcerative Colitis Using Trans abdominal Ultrasound: Cross Sectional Study

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ABSTRACT

Background: ulcerative colitis is one type of IBD and its prevalence is increasing worldwide and in Egypt and the disease itself carries a lot of sufferings and burden on the patients due to its chronic course and periods of relapse, ulcerative colitis needs regular follow up and monitoring, the use of ultrasound is being increased in diagnosis and follow upof IBD patients as a simple, reliable and non-invasive method.

Patients and methods: this study included a group of 30 ulcerative colitis patients in different disease activity and tested by the trans abdominal ultrasound to measure the wall thickness of sigmoid colon as marker of disease inflammation and activity.

Results: the study showed that there is a significant difference in the colonic wall thickness between different disease activity and showed that ultrasound is sensitive to detect this change in colonic wall thickness.

Conclusion: ultrasound in the hands of the trained personnel is a valuable tool to assess the activity of ulcerative colitis by detection of changes in the colonic wall thickness.

Keywords: Ulcerative Colitis; Trans abdominal Ultrasound; Colonic Wall Thickness

Introduction

Ulcerative colitis (UC) is one of two major forms of inflammatory bowel disease (IBD),IBD representing a chronic inflammatory illnessresponsible for much personal suffering that is occasionally disabling, interferes with the quality of life, imposes a significant burden on healthcare resources, and has important economic implications including workabsenteeism **(1)**.

Ulcerative colitis represents a chronic inflammatory condition that causes continuous mucosal inflammation of the colon wall. It affects the rectum and to a variable extent the colon in continuous fashion and is characterized by relapsing and intermittent course, diagnosis of ulcerative colitis is based basically on endoscopic and histopathological examination **(2).**

Ultrasonography is non-invasive method mainly used for evaluation of different abdominal organs, but not accurate in assessing the bowel. However, improvement in technology and increasing experience with sonography led to increase the role of

ultrasound in bowel diseases. Also, new techniques such as contrast-enhanced ultrasound increased this role **(3).**

The advantages of ultrasonography include the rapid evaluation of bowel wall thickness and also, visualization of the vascularization of the bowel using color Doppler. The third major advantage, in comparison to other cross-sectional imaging modalities, includes the direct visualization of motility **(4).**

Ultrasonography of IBD patients requires convex array probes of 3-5 MHz and higher frequency linear array probes from 5-15 MHz that allow adequate assessment of the five-layer wall pattern of the gastrointestinal tract, In patients with clinical features suggestive of ulcerative colitis, trans-abdominal ultrasonography can be used as an initial method for detection of the affected bowel segment **(5).**

Ultrasound has multiple possible uses in IBD: initial evaluation of clinically suspected patients of IBD, monitoring therapeutic response, suspicion of relapse, and detection of complication and extra intestinal manifestations ***(6).***

Patients and methods

This cross sectional studywas conducted in Tropical medicine departmentatZagazig University Hospitals in the period between July 2019 and December 2019 and included a total of 30 individuals of ulcerative colitis (UC) patients (14 male and 16 female).The patients with ulcerative colitis were further divided according to disease activity into 4 groups; 7 patients were in severe disease activity, 4 patients were in moderate disease activity, 7 patients were in mild disease activity and 12 patients were in clinical remission.

The diagnosis of ulcerative colitis was based on combination of clinical picture, endoscopic findings and histological examination of biopsy. Clinical severity of active UC (either in newly diagnosed patient or in relapse) was diagnosed based on Truelove and Witt's' classification **(7)** as it is simple and involves clinical and lab parameters with better assessment of patient condition.

Remission of UC in clinical practice was defined as a stool frequency $\leq$ 3/day with neither bleeding nor urgency, while relapse was defined as a flare of symptoms in a patient with established UC who was in clinical remission associated with rectal bleeding which was an essential component of relapse according to the 2nd European evidence-based consensus on the diagnosis and management of ulcerative colitis **(8).**

Patient less than 18 years old and patients with Crohn's disease, Ischemic colitis, Nonspecific colitis, Microscopic colitis and Portal hypertension were excluded from the study.

Table (1): Truelove and Witt's classification clinical index.

	Mild	Moderate	Severe	Fulminant
- Diarrhea	< 4	4-6	>6	>10
- Blood	No/ Intermittent	Moderately frequent	Frequent	Continuous
- Pulse	<90	≤90	>90	>90
- Temperature	<37.5	≤37.8	>37.8	>37.8
- Hb(g/dl)	>11.5	10.5-11.5	<10.5	Transfusion required
- ESR(mm/h)	<30	≤30	>30	> 30
- CRP(mg/L)	Normal	≤30	> 30	> 30
- Albumin (g/dl)	Normal	≤3	<3	<3

All patients were subjected to careful medical history taking and complete physical examination together with lab investigations (CBC,serum albumin ,serum creatinine,CRP ,ESR and INR) to evaluate the patient condition and disease activity.
The patients then examined with Transabdominal ultrasound; all the examinations were performed by a single operator using sonoscape S11 ultrasound machine with a low frequency (2-6MHz) curved-array transducer to general examination of all quadrants of abdomen for potential pathologic abnormalities like pathological distension, motility and para-intestinal structures such as abscesses. This was followed by examination using a high resolution linear-array transducer (4–12 MHz) for detailed examination of the bowel wall structure using a consistent technique and protocol: examination of the proximal to distal colon followed by complete examination of the small bowel. All the examinations were performed without any preceding preparation and without contrast material. The assessment focused on measurement of sigmoid colon wall thickness as a sign of disease activity.

Statistical analysis:
Results were tabulated and statistically analysedusing IBM SPSS software package version 20.0(Armonk, NY: IBM Corp). In all tests, P value below 0.05 was considered statistically significant.

Results:
The attained results showed that the age of the studied group was (34.1±12.1) ranged from (18to 59) years and (53.3%) of them were females **(Table 2)**.

The disease duration of the studied group was (55.5±65.8) ranged from (1to 240), (40.0%) of them had clinical remission, (23.3%) were Mild or severe disease activity and (13.3%) had moderate disease activity **(Table 3)**. The laboratory investigations of the studied group was showed in **Table (4)**.

Regarding correlation between disease severity and other patients' characteristics, this table shows there was statistically significant positive correlation

between disease severity with CRP and sigmoid colon wall thickness (increase disease severity was associated with higher CRP and sigmoid colon wall thickness) and there was statistically significant negative correlation between disease severity and albumin level (increase disease severity was associated with lower albumin level) with no statistically significant correlation between disease severity and any of other variables among the studied group. Regarding correlation between disease duration and other patients' characteristics, this table shows there was no statistically significant correlation between disease duration and any of other variables among the studied group **(Table 5)**.

There was statistically significant difference between patients with different disease activity regarding sigmoid colon wall thickness with increasing thickness with higher disease severity **(Table 6)**.

Sigmoid colon wall thickness among patients with different disease activity were shown in **Figure (1,2)**.

Our results showed sigmoid colon thicknessis a good predictor marker for detection of ulcerative colitis severity and activity with (80.0%) accuracy **(Table 7)**.

Table (2): Socio-demographic characteristics of the studied group:

Variable	**The case group(30)** **mean ± SD** **(Range)** **median**	
Age (years):	34.1±12.1 (18-59) 30.5	
Variable	**NO(30)**	**%**
Sex		
Male	14	46.7%
Female	16	53.3%

Table (3): Clinical data of the study group:

Variable	**The case group(30)** **mean ± SD** **(Range)** **median**
Disease duration (months):	55.5±65.8 (1-240) 24

Variable	NO(30)	%
Disease activity		
Clinical remission	12	40.0%
Mild disease activity	7	23.3%
Moderate disease activity	4	13.3%
Severe disease activity	7	23.3%

Table (4): Laboratory investigations of the studied group:

Variable	The studied group(30) mean ± SD (Range) median
ESR	30.5±18.3 (10-85) 24
CRP	18.6±19.3 (1.1-98.0) 14.5
Hb(g/dl)	11.9±1.5 (7.8-14.8) 12.0
platelets(10*3/dl)	196.3±46.3 (120-300) 190
WBCs(10*3/dl)	6.4±1.5 (4.5-11) 6
Albumin(g/dl)	3.8±0.6 (2.9-5.0) 3.9
Creatinine (mg/dl)	0.82±0.2 (0.55-1.3) 0.84
INR	0.92±0.11 (0.7-1.1) 0.9

Table (5): Correlation between disease severity and disease duration with patients' characteristics among the studied group:

Variables	*Disease severity*			*Disease duration*		
	r	**p**	**SIG**	**r**	**p**	**SIG**
Age	0.01	>0.05	NS	0.2	>0.05	NS
Disease duration	0.09	>0.05	NS	---------	---------	----------
ESR	0.02	>0.05	NS	0.3	>0.05	NS
CRP	**0.7**	**0.001****	**HS**	-0.1	>0.05	NS
Hb	-0.2	>0.05	NS	-0.1	>0.05	NS
platelets	0.06	>0.05	NS	-0.3	>0.05	NS
WBCs	0.3	>0.05	NS	-0.02	>0.05	NS
Albumin	**-0.6**	**0.001****	**HS**	0.02	>0.05	NS
Creatinine	0.3	>0.05	NS	0.1	>0.05	NS
INR	0.04	>0.05	NS	-0.07	>0.05	NS
Sigmoid colon wall thickness	0.8	**0.001****	**HS**	-0.3	>0.05	NS

*Statistically significant difference ($P \leq 0.05$), **statistically highly significant difference ($P \leq 0.001$), S= significant, HS= highly significant.

Table (6): Comparison between patients with different disease activity regarding sigmoid colon wall thickness:

Disease activity	**Number of patients (30)**	***Sigmoid colon wall thickness*(mm) mean ± SD (Range)**	**F test**	**p-value**	**LSD**
Clinical remission	12	2.43±0.54 (1.7-3.9)	17.8	**0.001****	0.6 (1) **0.01* (2)** **0.001**(3)** 0.05 **(4)** **0.001**(5)** **0.009* (6)**
Mild activity	7	2.7±0.31 (2.3-3.1)			
Moderate activity	4	3.85±0.48 (3.4-4.4)			

Severe activity	7	5.5±1.7 (2.1-7.0)			

*Statistically significant difference (P ≤ 0.05), **Statistically highly significant difference (P ≤ 0.001)
(1) Clinical remission versus mild activity group, (2) Clinical remission versus moderate activity group
(3) Clinical remission versus severe activity group, (4) Mild activity versus moderate activity group
(5) Mild activity versus severe activity group,(6) Moderate activity versus severe activity group

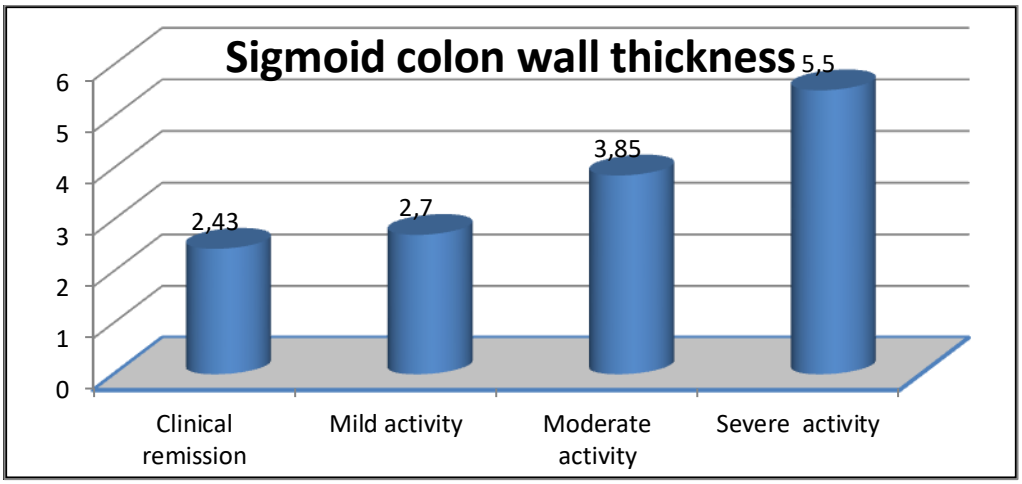

Figure (1): Bar chart for sigmoid colon wall thickness among patients with different disease activity.

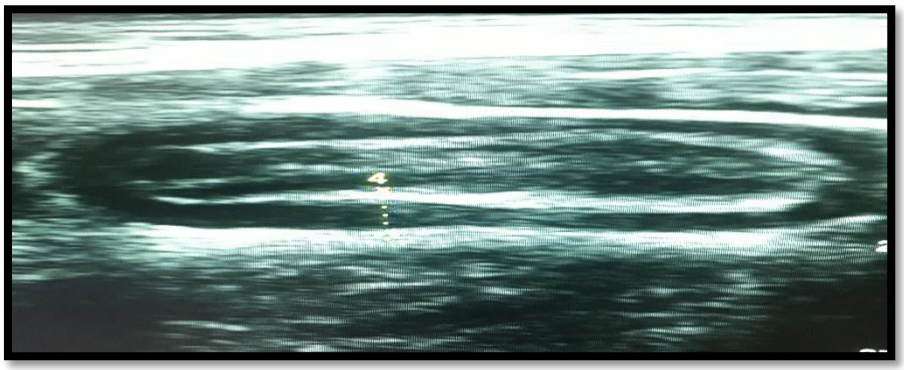

Figure (2): Sigmoid colon wall thickness measurement demonstrating wall thickening.

Table (7): Accuracy o f sigmoid colon thickness in detection of disease activity:

Variable	Sensitivity	Specificity	PVP	PVN	Accuracy
Sigmoid colon thickness	83%	77%	80%	75%	80%

Discussion

In the present study 30 patients were diagnosed with UC, based on clinical, endoscopic and histopathological examinations, were recruited at different disease activity and examined using intestinal US (IUS) by measuring the sigmoid colon wall thickness as a sign of inflammation and disease activity. Results were documented

and correlated with the demographic, clinical and laboratory data of the patients under study. The mean value of sigmoid colon wall thickness among all patients was (3.4±1.5mm), while the mean value in severe disease (5.5±1.7mm), moderately active disease (3.85±0.48mm), mild active disease (2.7±0.31mm) and clinical remission (2.43±0.54mm). Thus current study showed statistically significant difference among different disease activities regarding sigmoid colon wall thickness (p=0.001) with increasing wall thickness with higher disease activity with high sensitivity (83%). Similar results were obtained from **Maconi et al. (9), Ruess et al. (10) and Bremner et al. (11),** they stated that the degree of bowel wall thickness, as evaluated by US correlated with clinical, biochemical and endoscopic activity of UC, both before and after treatment.

In consistent with our results, another study by **Carter and Eliakim (12)** showed that the sensitivity of US for detection of bowel wall thickness was 90%, and demonstrated that bowel US is useful and feasible imaging tool for the detection of the inflammation and complications of IBD, and suggested that bedside bowel US can be a part of non-invasive examination modalities in IBD patients. The TRUST&UC study, was the largest multi-center study investigating the use of bowel US in patients with UC, clearly demonstrated the high sensitivity of bowel US to detect disease activity and therapeutic response and clearly support bowel US as a non-invasive monitoring tool for UC **(13)**. On the other hand, other studies (**Shirahama et al., (14),Bavil et al. (15)** found no significant difference in bowel wall thickness between active and inactive phases of UC while there was significant difference regarding intramural blood flow. They explained the non-correlation between bowel wall thickness and disease activity may be due to small number of patients. While they included 50 patients, in our study only 30 patients were included, but we have significant correlation between the bowel wall thickness and the disease activity, so, it cannot be explained based on the number of patients, but other factors may be related to operator experience in doing US or patient factors (fasting versus after meal), may underlie such difference in the results.

Regarding inflammatory markers, our study showed that CRP mean value is (18.6±19.3) with statistically significant difference (p=0.001) among patient groups; severe activity (43.5±28.5), moderate activity (21.7±4.5), mild activity (10.3±6.5) and clinical remission (7.85±4.4) is present, this was consistent with **Osada et al., (16)** who reported that CRP is often high in moderate and severe UC, and is more sensitive than ESR because of shorter half-life. **Rubin et al., (17)** reported the same results stating that although ESR and CRP are nonspecific markers and may be elevated with other systemic inflammation, they correlate with the endoscopic disease activity. **Magro et al., (18)**also,documented that with exception of proctitis, CRP broadly correlate with clinical severity and elevated CRP is generally associated with elevated ESR and hypoalbuminemia in acute severe activity. Hence, Ulcerative colitis is becoming of an important interest due to increase in its prevalence in Egypt ***(19)*.**

Conclusion:

In our study US has proved sensitive and reliable to detect changes in the colonic wall thickness and differentiate between different degrees of activity among UC patients and thus might be used in diagnosis and follow up UC patient.

This study has certain limitations. The patients were not subjected to any treatment, therefore response to therapy was not evaluated. In addition other ultrasound modalities including color Doppler, sonoelastograghy and contrast enhanced sonography were no applied

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