RESEARCH ARTICLE

Narrow band imaging as a noninvasive tool for evaluation of the severity of inflammation in patients with ulcerative colitis in Kafr-El-Sheikh university, Egypt

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Abstract

Objective: To analyse the effectiveness of narrow-band imaging in determining the severity of inflammation in ulcerative colitis patients in relation to histological activity.

Method: The cross-sectional study was conducted at Kafrelsheikh University Hospital, Egypt, from June 2021 to May 2022, and comprised patients regardless of age and gender who had ulcerative colitis and visited the endoscopy unit. After taking detailed history, the patients were subjected to physical examination and laboratory tests which included complete blood count, international normalised ratio, erythrocyte sedimentation rate and faecal calprotectin. Colonoscopy with narrow-band imaging, biopsy and histopathological assessment were done as part of clinical evaluation. Data was analysed using SPSS 20.

Result: Of the 100 patients, 55(55%) were male and 45(45%) were females. The overall mean age was 33.72±10.29 years (range: 11-56 years). There were 73(73%) patients who were married, 12(12%) had positive family history and 19(19%) were smokers. Besides, 18(18%) patients received biological therapy. There was significant positive correlation between histopathological and endoscopic scores ($p<0.05$). Also, there was a significant positive correlation between histopathological score and findings of narrow-band imaging ($p<0.05$). There were 10(10%) patients who were found to have dysplasia that was not diagnosed with colonoscopy.

Conclusion: Narrow-band imaging was found to have a significant correlation with the histologically determined degree of inflammation.

Keywords: Narrow-band imaging, Ulcerative colitis, Histological scoring, Smokers, Leukocyte L1 antigen complex, Colonoscopy, Biopsy, Inflammation, Biological therapy.

DOI: 10.47391/JPMA.EGY-S4-16

Introduction

Ulcerative colitis (UC) is defined as chronic inflammation that affects the intestinal mucosa. The condition typically starts with rectal irritation and can occasionally spread to the whole colon.[1,2] Chronic recurrent inflammation causes dysplastic alterations in the colonic mucosa and increases the risk of colon cancer in people with pancolitis.[3] Colonoscopy is advised for screening people for colorectal cancer who have had UC for more than 8 years.[4,5]

To achieve clinical remission and mucosal repair are the recommended goals for treating UC patients. The disappearance of colonic inflammation and ulcers serves as a marker for mucosal healing, which is typically accompanied with clinical remission. Despite mucosal healing, however, moderate histological inflammation has been observed in many cases. One of the widely utilised scores for evaluating disease activity is the Mayo scoring system (MES).[6,7]

Due to the difficulties in distinguishing between dysplastic and healthy mucosa, diagnosing dysplasia requires at least 32 biopsies; 4 specimens from every 10 cm is highly recommended. There is a significant need for an enhanced technique to direct the site of biopsy because these samples are random, and do not reflect the whole colon.[8] The identification of dysplasia during colonoscopy has been significantly enhanced by advanced endoscopic techniques, such as chromoendoscopy (CE) and narrow-band imaging (NBI).[9,10] NBI improves mucosal surface features and vasculature, and provides the greatest contrast between the microvasculature and the adjacent mucosa, relying on the application of sequential green and blue lights.[11,12] NBI is more accurate than CE and traditional colonoscopy in detecting colorectal neoplasia, and is now regarded as a cutting-edge method to evaluate the level of inflammation in UC patients.[13]

The current study was planned to determine the effectiveness of NBI in diagnosing the severity of

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inflammation in UC patients in relation to histological activity.

Patients and Methods

The cross-sectional study was conducted at Kafrelsheikh University Hospital, Egypt, from June 2021 to May 2022. After approval from the institutional ethics reciew committee, the sample was raised using comprehensive sampling technique, and all UC patients regardless of age and gender who visited the endoscopy unit were enrolled after taking written informed consent from the patients or their parents/guardians.

After taking detailed history, the patients were subjected to physical examination and laboratory tests, including complete blood count (CBC), international normalised ratio (INR), erythrocyte sedimentation rate (ESR), C-reactive protein (CRP) and faecal calprotectin.

All patients were subjected to colonoscopy, NBI, biopsy, and histopathological evaluation. Colonoscopy was performed with a colonoscope (Olympus CF-170HL). When an inflamed area was found, the white light was used first, and then changed to the NBI mode. This area was subjected to biopsy for histopathological analysis (Figure 1). The Mayo Endoscopic Score (MES) was used to measure activity, and a score of >2 indicated disease activity[12] (Table 1).

Three categories were created on the basis of NBI; obscure implied an inactive disease where the capillary network was not clearly visible; visible meant it was easy to see the network; and dilated indicated that the capillaries' diameters were larger than those of the nearby capillaries. Active inflammation was both visible and dilated.

Following rapid fixation in 10% formalin, routine histological processing, paraffin embedding and microtomy were performed on tissue samples for histopathological evaluation. The biopsy samples were stained with haematoxylin and eosin (H&E). The pathologist was blinded to clinical and endoscopic data. The disease's histopathological activity was graded according to the Geobes score (Figure 2).[14] In addition, the presence or absence of dysplasia was evaluated, and, if present, it was graded (Table 2).

Data was analysed using SPSS 20. Mean values and standard deviations were used to express quantitative variables, while frequencies and percentages were used for of categorical variables. Chi-square test was used to compare the parameters, and for trend-testing of ordinal binary data. To validate presumptions for use in parametric tests, Kolmogorov-Smirnov (distribution-type) and Levene (homogeneity of variances) tests were used. Independent sample t tests for normally distributed data, and Mann Whitney tests for not normally distributed data were used to compare quantitative data. To calculate the likelihood that a risk factor will result in a particular health issue, binary regression analysis was performed. The strength and direction of the link were assessed using the Spearman rank correlation coefficient analysis. $P<0.05$ was considered significant.

Results

Of the 100 patients, 55(55%) were male and 45(45%) were females. The overall mean age was 33.72±10.29 years (range: 11-56 years). There were 73(73%) patients who were married, 12(12%) had positive family history and 19(19%) were smokers. Besides, 18(18%) patients received biological therapy (Table 3).

MES was grade 13(13%), grade 39(39%), grade 34(34%), and grade 14(14%) patients. NBI revealed that 16(16%) patients had obscure, 62(62%) had visible and 22(22%) had dilated bands. Histopathological evaluation that 25(25%) patients had Geboes score >3. There were 10(10%) patients who had biopsies showing dysplasia (Table 4).

There was a significant relation of disease severity assessed by Geboes score with MES and NBI (Table 5).

MES 2-3could predict Geboes score >3 with 96% sensitivity, 68% specificity, 50% positive predictive value (PPV), 98.1% negative predictive value (NPV) and 75% overall accuracy. The corresponding values for MES 3 were 44%, 96%, 78.6%, 87.3% and 83% (Table 6).

Visible/dilated findings on NBI could predict severe Geboes score >3 with 100% sensitivity, 65.3% specificity, 21.3% PPV, 100% NPV and 71% overall accuracy. The corresponding values for dilated category alone were 84%, 98.7%, 95%, 94.9% and 95% (Table 7).

Table-1: The Mayo endscopic scoring (MES) system for ulcerative colitis.

Score(0)	normal or inactive disease
Score(1)	Mild disease (erythema, decrease vascular pattern, mild friability)
Score(2)	Moderate disease (marked erythema, absent of vascular pattern, friability, erosions)
Score(3)	Severe disease, spontaneous bleeding, ulceration)

Table-2: The original Geboes score.

Grade 0: Architectural changes	0.0 No abnormality
	0.1 Mild abnormality
	0.2 Mild/moderate diffuse or multifocal abnormalities
	0.3 Severe diffuse or multifocal abnormalities
Grade 1: Chronic inflammatory infiltrate	1.0 No increase
	1.1 Mild but unequivocal increase
	1.2 Moderate increase

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Table-2: *continued from previous page*

	1.3 Marked increase
Grade 2A: Eosinophils in	2A.0 No increase
lamina propria	2A.1 Mild but unequivocal increase
	2A.2 Moderate increase
	2A.3 Marked increase
Grade 2B: Neutrophils in	2B.0 No increase
lamina propria	2B.1 Mild but unequivocal increase
	2B.2 Moderate increase
	2B.3 Marked increase
Grade 3: Neutrophils	3.0 None
in epithelium	3.1 < 5% crypts involved
	3.2 < 50% crypts involved
	3.3 > 50% crypts involved
Grade 4:	4.0 None
Crypt destruction	4.1 Probable - local excess of neutrophils in part of the crypts
	4.2 Probable - marked attenuation
	4.3 Unequivocal crypt destruction
Grade 5: Erosions	5.0 No erosion, ulceration or granulation tissue
and ulcerations	5.1 Recovering epithelium + adjacent inflammation
	5.2 Probable erosion: focally stripped
	5.3 Unequivocal erosion
	5.4 Ulcer or granulation tissue

Table-3: Demographic and laboratory data.(n=100).

	n (%)	
Gender:		
Male	55 (55)	
Female	45 (45)	
Marital status:		
Unmarried	27 (27)	
Married	73 (73)	
Smoking:		
Non-smokers	81 (81)	
Smokers	19 (19)	
Family history:		
Positive	12 (12)	
Negative	88 (88)	
Age (year):		
Mean ± SD	33.72 ± 10.29	
Range	11 – 56	
Biological therapy:	18 (18)	
Laboratory Data	**Mean ± SD**	**Range**
Haemoglobin (g/dl)	11.8 ± 1.33	10.0 – 15.8
Platelet (103/mm3)	238.18 ± 72.28	156 – 454
TLC (103/mm3)	6.77 ± 1.17	4.5 – 9.6
	Median	**Interquartile range**
Faecal calprotectin (mcg/g)	370	205– 598
ESR 1st hour (mm/hr)	15	11 – 30
ESR 2nd hour (mm/hr)	35	22 – 50

SD: Standard deviation, TLC: Total leukocyte count, ESR: Erythrocyte sedimentation rate.

Table-4: Mayo score, NBI and histopathological findings (N=100).

	n (%)
Mayo score:	
0	13 (13)
1	39 (39)
2	34 (34)
3	14 (14)
0 – 1	52 (52)
2 – 3	48 (48)
EC-NBI:	
Obscure	16 (16)
Visible	62 (62)
Dilated	22 (22)
Geboes score	
≤3	75 (75)
>3	25(25)
Dysplasia	10 (10)

EC-NBI: Endocytoscopic narrow-band imaging.

Table-5: Association of Geboes score with MES and NBI findings.

Parameter	**Geboes score**		**Test**	
	≤3 N=75 (%)	**>3 N=25 (%)**	**χ2**	***p-value***
Mayo score:				
0	13 (17.2%)	0 (0%)	34.596	<0.001**
1	38 (50.7%)	1 (4%)		
2	21 (28%)	13 (52%)		
3	3 (4%)	11 (44%)		
NBI findings:	16 (21.3%)	0 (0%)	53.334	<0.001**
Obscure	58 (77.3%)	4 (16%)		
Visible Dilated	1 (1.3%)	21 (84%)		

MES: Mayo endoscopic score, NBI: Narrow-band imaging. χ2Chi square for trend test **p≤0.001 = statistically highly significant.

Table-6: Agreement between MES and Geboes score.

MES	**≤3 N=75 (%)**	**>3 N=25 (%)**	***r-value***	***p-value***
0	13 (17.3%)	0 (0%)	**0.594**	**<0.001****
1	38 (50.7%)	1 (2.6%)		
2	21 (28%)	13 (52%)		
3	3 (4%)	11 (44%)		

	Sensitivity	**Specificity**	**PPV**	**NPV**	**Accuracy**	**kappa**	***p-value***
MES(≥2)	96%	68%	50%	98.1%	75%	0.49	<0.001**
MES (3)	44%	96%	78.6%	87.3%	83%	0.469	<0.001**

MES: Mayo endoscopic score. **PPV: Positive predictive value, NPV: Negative predictive value, r = Spearman rank correlation coefficient, **p≤0.001 = statistically highly significant.**

Table-7: Agreement between NBI and Geboes score.

NBI	**Geobas≤3 N=75 (%)**	**Geobas>3 N=25 (%)**	***r-value***	***p-value***
Obscure	16 (21.3%)	0 (0%)	**0.747**	**<0.001****
Visible	58 (77.3%)	4 (16%)		
Dilated	1 (1.3%)	21 (84%)		

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Table-2: *continued from previous page*

	Sensitivity	Specificity	PPV	NPV	Accuracy	kappa	*p-value*
Visible+ dilated	100%	65.3%	21.3%	100%	71%	0.119	0.012*
Dilated	84%	98.7%	95%	94.9%	95%	0.861	<0.001**

NBI: Narrow-band imaging, PPV: Positive predictive value, NPV: Negative predictive value, **r = Spearman rank correlation coefficient, **p≤0.001 = statistically highly significant.**

severity and the response to therapy. Endoscopic remission gives an improved prognosis in UC patients and is considered a treatment goal.[15]

Many studies have reported the correlation between the severity of inflammation and the frequency of relapse or dysplasia.[16,17] However, few studies have addressed the

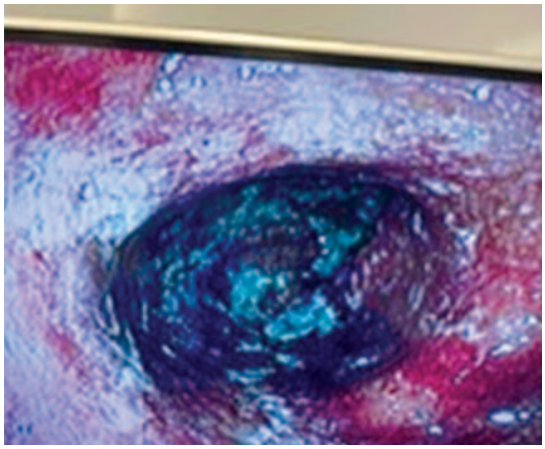

Image of UC patient by NBI

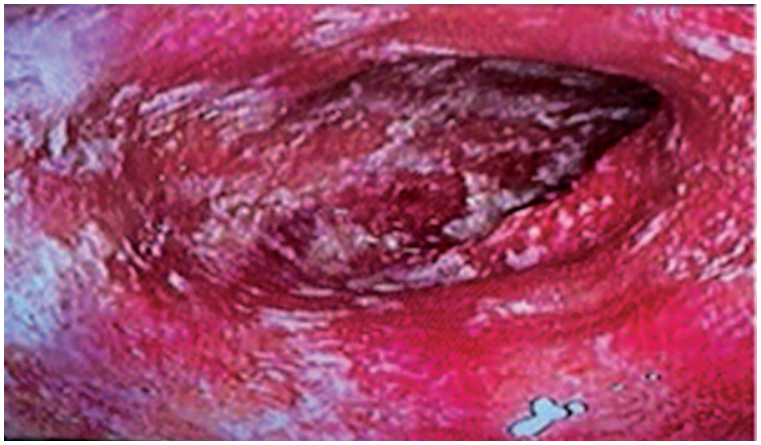

Image of UC patient by white light

Figure 1: Examination by white light and NBI. UC: Ulcerative colitis, NBI: Narrow-band imaging.

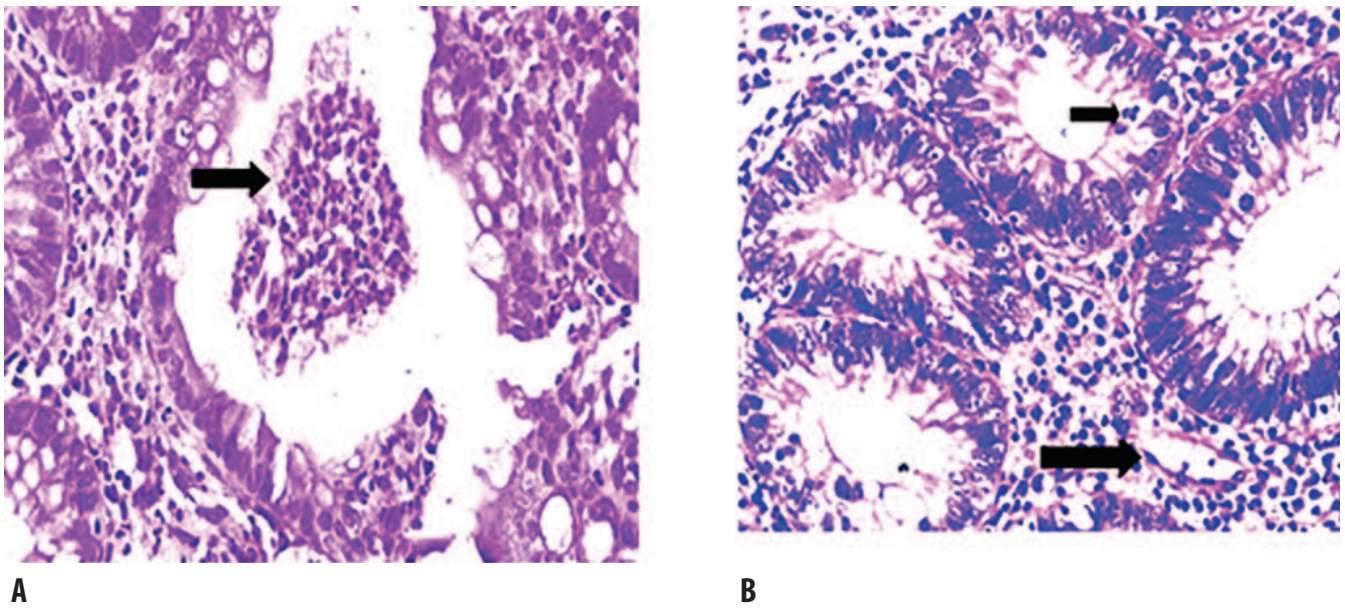

Figure 2: (A) Case of ulcerative colitis with Geboes score 4.1 showing local excess of neutrophils inside the crypt lumen forming a crypt abscess (arrow) and crypt destruction (haematoxylin and eosin [H&E] x 400). (B) Case of ulcerative colitis with Geboes score 3.3 showing intraepithelial neutrophils (arrow) and moderate dysplasia of the crypt epithelium in the form of epithelial stratification, hyperchromatism, pleomorphism and mucodepletion (H&E x 400).

Discussion

UC is a chronic inflammatory disease manifested by bleeding per rectum, diarrhoea and abdominal cramps. Colonoscopy plays a major role in the evaluation of UC correlation between colonoscopy and histopathological scores. A more advanced modality, such as NBI, is needed for the accurate assessment of acute inflammation.[18]

The current study observed that NBI can be used to visualise areas of abnormal vascular pattern that are not noticed by the white light. A notable finding was the correlation between the NBI and Geboes score, where dilated vessels were associated with high Geboes score. Previous studies reported an increase in vascularity closely correlated with UC severity.[19,20] A study examined all colonic segments and documented a fair correlation between NBI and histopathological activity.[21] Another study assessed the rectal mucosa using the advanced technique that allowed magnification of cells and nuclei.[22]

The current study reported that histological activity was closely correlated with endoscopic activity in UC patients. Most biopsies with MES >3 demonstrated disease activity on biopsy with Geboes score >3. A similar study reported that endoscopic activity was related to the histological activity.[23]

The current study has limitations as the sample size was small and was not calculated which may have affected the power of the study. Future studies with a larger sample size are recommended.

Conclusions

NBI was found to be a simple method having significant correlation with the histologically-determined degree of inflammation. NBI has the potential of directing the biopsy location in order to better evaluate dysplasia and inflammation.

Disclaimer: None.

Conflict of Interest: None.

Source of Funding: None.

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