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IMAGE-ENHANCED ENDOSCOPY IS SPECIFIC FOR THE DIAGNOSIS OF NON-EROSIVE GASTROESOPHAGEAL REFLUX DISEASE

Neil D. Parikh, MD^{#1,2}, Artur V. Viana, MD^{#1,2}, Saloni Shah³, and Loren Laine, MD^{1,2}

¹Section of Digestive Diseases, Yale School of Medicine, New Haven, CT

²VA Connecticut Healthcare System, West Haven, CT

³Northeastern University, Boston, MA

[#] These authors contributed equally to this work.

Abstract

Objectives: We assessed the performance characteristics of image-enhanced endoscopy with i-Scan or narrow band imaging (NBI) in patients with non-erosive GERD compared to controls without heartburn.

Material and Methods: Image-enhanced endoscopic findings of vascularity at the squamo-columnar junction, distal esophageal micro-erosions, and non-round pit pattern at the squamo-columnar junction were assessed in cases (heartburn not responsive to PPIs, positive results on validated GERD questionnaire, no esophageal erosions, esophageal biopsies with histologic evidence of GERD (basal cell hyperplasia, elongation of papillae, and dilation of intercellular spaces all required)) and in controls (no GERD symptoms or esophageal erosions).

Results: Twenty cases and 60 controls were compared. The pre-defined features were more common in cases vs. controls: vascularity RR=4.9 (95% CI 2.4–10.0), specificity=86.7%; micro-erosions RR=9.7 (3.6–26.5), specificity=93.3%; non-round pit pattern RR=2.4 (1.7–3.3), specificity=60.0%; combination of vascularity and micro-erosions RR=30.0 (4.1–220), specificity=98.3%. These differences were consistent with both i-Scan and NBI.

Conclusions: Image-enhanced endoscopic findings of vascularity and micro-erosions were very specific for non-erosive GERD. Image-enhanced endoscopy may be useful in real-time diagnosis of non-erosive GERD when patients undergo upper endoscopy for heartburn. The relative utility of image-enhanced endoscopy vs. pH-impedance monitoring, based on efficacy, cost, and patient acceptance, requires additional study.

Correspondence (to Loren Laine, M.D.) and address for all authors: Section of Digestive Diseases P.O. Box 208019, Yale School of Medicine, New Haven, CT 06520-8019, Phone: 203-937-2462. N. Parikh: nparikh.md@gmail.com; A. Viana: artur.viana@yale.edu; S. Shah: saloni.shah@yale.edu; L. Laine: loren.laine@yale.edu.

Biographical note: Neil Parikh was a GI fellow at Yale School of Medicine and now is a practicing gastroenterologist; Artur Viana is a GI fellow at Yale School of Medicine; Saloni Shah performed a research elective at Yale School of Medicine as a college student at Northeastern University; Loren Laine is a Professor of Medicine at Yale School of Medicine and past president of the American Gastroenterological Association

Keywords

Gastroesophageal reflux; heartburn; endoscopy; gastrointestinal; image enhancement

INTRODUCTION

Although most patients with gastroesophageal reflux disease (GERD) symptoms respond to proton-pump inhibitor (PPI) therapy, up to 40% of patients may have persistent symptoms^{1,2}. These patients typically undergo an upper endoscopy but most will have no evidence of erosive esophagitis on standard white-light endoscopy. In the absence of erosive esophagitis on upper endoscopy, testing with intraesophageal pH or impedance-pH monitoring is currently the primary method used to assess for GERD after endoscopy in patients with heartburn in clinical practice³. However, this testing is uncomfortable for patients, time-consuming, and leads to additional costs^{4,5}. A technology that allows for diagnosis of non-erosive GERD at the initial upper endoscopy without additional uncomfortable interventions, time, or resources would improve patient care and satisfaction while reducing healthcare expense.

Image-enhanced endoscopy (IEE) has shown efficacy in classifying colorectal polyps as neoplastic versus non-neoplastic and in identifying dysplasia in endoscopic screening and surveillance for Barrett's esophagus. Two of the commercially available IEE modalities are i-Scan (Pentax, Tokyo, Japan) and narrow band imaging (NBI; Olympus, Tokyo, Japan). i-Scan uses proprietary computed data algorithms to provide post-image processing and visual enhancement. NBI uses filters in front of the light source to provide tissue illumination and emphasize vascular structures in the superficial mucosa and the deeper mucosa⁶. IEE characteristics that cannot be appreciated in white-light endoscopy have been suggested to be associated with heartburn or GERD: increased vascularity at the squamo-columnar junction, presence of "micro-erosions", and a non-round pit pattern at the squamo-columnar junction⁷⁻¹³. An increased number of intra-papillary capillary loops (IPCLs) seen on NBI also has been reported to be associated with non-erosive GERD⁷⁻⁹.

We aimed to evaluate the utility of IEE in the diagnosis of non-erosive GERD by comparing specific IEE findings in patients with symptoms and histological findings of non-erosive GERD and in controls without heartburn or erosive esophagitis. We included only patients with heartburn not responsive to PPI therapy because this is the group that would typically undergo endoscopy to assist in diagnosis and management in clinical practice. Current guidelines recommend endoscopy for patients with GERD symptoms that persist despite medical therapy, but not for diagnosis or management in patients with GERD symptoms (and no alarm features) that responds to PPI therapy¹⁴.

MATERIAL AND METHODS

Patients

We conducted a prospective cohort study at Yale-New Haven Hospital Temple Endoscopy Center (New Haven, CT) and VA Connecticut Healthcare System Endoscopy Unit (West

Haven, CT) between August, 2015 and June, 2016. Patients scheduled for an upper endoscopy for heartburn (defined as burning beneath the breastbone) that had not responded to PPI therapy as part of their standard clinical evaluation were eligible for enrollment as cases. Controls were patients undergoing upper endoscopy for the following indications: iron deficiency anemia, weight loss, diarrhea, and screening for esophageal varices. Consecutive patients were enrolled on the days an investigator was present in the endoscopy unit.

Both cases and controls completed the validated GerdQ questionnaire immediately prior to their endoscopy^{15,16}. In addition to the symptom of heartburn, cases also were required to have a positive result on the GerdQ questionnaire (score ≥ 8) to be eligible for inclusion; controls were excluded if they had symptoms of heartburn or regurgitation or if they had a GerdQ score above 2^{15,16}. Patients with erosive esophagitis on white-light endoscopy, whether potential cases or controls, were excluded. Furthermore, patients were only included as cases if they had histologic evidence of GERD as defined by the presence of all of the following: basal cell hyperplasia, elongation of papillae, and dilation of intercellular spaces¹⁷. Cases also were to be scheduled following endoscopy for 24-hour pH-impedance monitoring.

The study was approved by the Institutional Review Boards at Yale University and the Veterans Administration Connecticut Healthcare System and registered on clinicaltrials.gov (NCT02629081). Study participants provided written informed consent.

Endoscopic Examination

White-light endoscopy was performed first in all patients. Subsequently, examination with IEE was performed: i-Scan (mode 1) was used in the patients enrolled at Temple Endoscopy Center and NBI in the patients at the Veterans Administration Endoscopy Unit. The IEE features assessed on both i-Scan and NBI were the following: vascularity at the squamo-columnar junction, micro-erosions of the distal esophagus, non-round pit pattern at the squamo-columnar junction, and increased IPCLs in the distal esophagus. Two random biopsies (at 12 and 6 o'clock) were obtained at 2 cm above the squamo-columnar junction in patients with heartburn (controls did not undergo biopsy because it was not considered standard of care in patients without esophageal symptoms) to assess for the histological features indicating reflux disease described above.

All participating endoscopists underwent training on IEE. The training session included an orientation in which the technology was described followed by samples of normal esophageal images. After viewing normal images, images of the pre-defined abnormal esophageal features for i-Scan and NBI were reviewed. Following the orientation, the endoscopists completed a brief post-training quiz where they made “in-vivo” decisions of normal or abnormal esophageal images on IEE and received feedback on their answers.

Outcomes and Analyses

The primary outcome was the predefined IEE feature of vascularity and the other key secondary outcomes were the other two predefined IEE features of micro-erosions and non-

round pit pattern as well as combinations of these three features. An exploratory outcome was the presence of increased IPCLs.

The primary analysis of the study was comparison of vascularity in cases and controls. In addition, comparisons of the other predefined IEE outcomes and combinations were performed between cases and controls. We also determined the sensitivity, specificity, positive predictive value, and negative predictive value of the these IEE features for symptomatic non-erosive GERD. We also had planned to perform an analysis restricting cases to those with pH-impedance testing confirming reflux disease, but were unable to do this analysis because few patients chose to have pH-impedance testing performed. We also planned separate analyses for NBI and i-Scan. Comparisons of categorical variables was performed with Fisher exact test.

Based on previous literature, we hypothesized that the detection of increased vascularity would be 35% in controls and 55–60% in patients with non-erosive GERD. To document a difference of 22.5% (35% in controls and 57.5% in cases) with an alpha of 0.05 and power of 0.80 we required a sample size of 76 cases and 76 controls. We therefore planned on enrolling 80 patients in each arm. However, the study was terminated prematurely due to departure of the investigator leading the study.

RESULTS

Patient Characteristics

Twenty cases meeting the criteria for non-erosive GERD and 60 controls were included. Table 1 provides selected characteristics of the study groups. Ninety percent or more of the patients were male in both groups. NBI was employed somewhat more commonly than i-Scan in both groups.

Findings on Image-Enhanced Endoscopy

The frequency of each of the primary and secondary IEE characteristics and the respective relative risk (RR) for cases vs. controls for each feature are shown in Table 2. Each IEE characteristic was significantly more common in the cases, with RRs for individual features from 2.4 to 9.7. All combinations of features were also significantly more common in the cases. Our exploratory assessment of increased IPCLs also showed a strong association with RR=5.5.

Performance characteristics of the IEE findings in all cases are shown in Table 3. Micro-erosions and vascularity were uncommon in controls (6.7% and 13.3% respectively), leading to relatively high specificities of these individual findings (93.3% and 86.7%). The combination of micro-erosions and vascularity had a specificity of 98.3%, given that only 1 of 60 controls had both these features.

Results broken down for NBI and i-Scan are shown in Table 4. Both modalities showed the predefined findings of vascularity, micro-erosions, and non-round pit pattern to be more frequent in non-erosive GERD patients than in controls. The exploratory feature of increased IPCLs was uncommonly identified with i-Scan.

DISCUSSION

We used the commonly available endoscopy-based IEE techniques, NBI and i-SCAN, to study a group of patients with PPI-refractory non-erosive GERD, based on classic heartburn symptoms despite PPI therapy, positive results on a validated GERD questionnaire, and histologic findings confirming GERD. We chose to study IEE characteristics that have been shown to have good to excellent interobserver agreement in prior studies^{8,10}: our primary IEE feature was vascularity, secondary features were micro-erosions and non-round pit pattern, and an exploratory feature was increased IPCLs.

The RR of vascularity on IEE in patients with non-erosive GERD as compared to controls was 4.9, while the RR of micro-erosions was 9.7. When both findings were identified, which occurred in approximately half the cases, the RR was 30 for non-erosive GERD vs. controls. Increased IPCLs were also more than 5-fold more common with non-erosive GERD than controls. Specificities of 90% or greater were seen for micro-erosions and for any combination of 2 of the 3 pre-specified findings, vascularity, micro-erosions, and non-round pit pattern. For patients with vascularity and micro-erosions the specificity was over 98%. Sensitivities were somewhat lower, ranging from 65% for vascularity and micro-erosions to 95% for non-round pit pattern. Furthermore, both types of commonly available IEE modalities, NBI and i-Scan, performed well for these 3 pre-defined findings: each finding was much more common in non-erosive GERD cases than controls for both NBI and i-Scan.

A problem with studies of non-erosive GERD is that no criterion standard exists for a definitive diagnosis. Similar to other studies we used the presence of the classic GERD symptom of heartburn and a positive score on a validated GERD questionnaire. Other diagnostic testing for a diagnosis of GERD may include histologic exam, pH monitoring, and pH-impedance monitoring. To provide greater certainty that our cases likely represented non-erosive GERD we used a rigorous definition for a histologic diagnosis of GERD, requiring all three of the standard histologic features of GERD: basal cell hyperplasia, elongation of papillae, and dilation of intercellular spaces. Savarino et al have shown that these features are uncommon in patients with functional heartburn (based on pH-impedance testing), being found in only 6.7% of such patients¹⁷(and personal communication, E. Savarino). Thus, our 20 patients with a diagnosis of histologic GERD are very unlikely to have functional heartburn.

The literature on endoscopy-based IEE systems such as NBI and i-Scan for non-erosive GERD is limited and no studies have specifically focused, as we did, on patients who do not respond to PPI therapy, which is the population relevant to real-world clinical practice. Three NBI studies have assessed the prevalence of the changes we evaluated in a cross-section of patients with non-erosive GERD as compared to patients with erosive GERD and non-GERD controls. It is important to note that two of these three studies^{8,9} used endoscopes with enhanced optical magnification technology that are not readily available in the United States. In all cases, the diagnosis of GERD was based on symptoms and a positive GERD questionnaire; a response to PPI therapy was required for a diagnosis of non-erosive GERD in 2 studies^{9,10} while PPI use or response was not mentioned in the third⁸. No additional supporting evidence such as histology or pH-impedance monitoring was provided.

Vascularity (92% vs. 37%, 25% vs. 7%)^{8,10}, non-round pit pattern (90% vs. 30%, 94% vs. 30%)^{9,10}, and increased IPCLs (80% vs. 20%, 55% vs. 13%)^{8,9} were more common in non-erosive GERD than controls, with prevalences similar in non-erosive and erosive GERD. Micro-erosions were also more common with non-erosive GERD than controls, (30–53% vs. 0 in 2 studies and 23% in the third), and tended to be higher with erosive than non-erosive GERD^{8–10}. Results in two of these three studies^{8,9} were based on a post hoc review of images rather than the real-time assessment performed in our study.

Two studies of i-Scan assessed patients with reports of GERD symptoms (but no documentation of a validated questionnaire); most patients were not on PPI therapy^{11,12}. The investigators assessed a group of poorly characterized non-erosive changes such as blurred z-line, mucosal coarseness, hyperemic or purplish discoloration, gastric mucosal inlet, erythema, and polypoid abnormalities. In one study changes were identified with white light endoscopy in 60 of 71 patients and an additional 9 patients with use of i-Scan¹¹, while in the other study the total number of such abnormalities was higher with i-Scan than white-light endoscopy¹². Results of both studies were based on review of images rather than real-time assessment.

A more recent study included patients with dyspepsia who were stratified into those with and without GERD symptoms based on a GerdQ score¹⁸; many patients also underwent 24-hr pH monitoring. GERD diagnosis was based on intra-esophageal acid exposure, positive symptom index or symptom association probability, or erosive esophagitis, unrelated to presence or absence of GERD symptoms. Minimal change esophagitis was defined by punctate erythema, elongated pit pattern of gastric mucosa with triangular lesion at the squamocolumnar junction, minute erosion, or blurred palisade blood vessel at the distal esophagus on i-Scan. These changes were not significantly different in prevalence on comparison of positive vs. negative GERD symptoms and of positive vs. negative GERD diagnosis, but were significantly higher in dyspeptic patients with or without GERD symptoms and in patients with a GERD diagnosis than in controls.

Our study has limitations. We did not enroll our planned sample size due to the departure of our lead investigator. However, the differences between non-erosive GERD patients and controls in our primary and secondary outcomes were larger than hypothesized in our sample size calculation. Thus, large and clinically meaningful differences were still demonstrated with the smaller number of patients, although confidence intervals around our results are broad. In addition, a criterion standard for non-erosive GERD does not exist. Although we provided objective evidence of reflux disease by performing distal esophageal biopsies and also used a validated GERD questionnaire for assignment to case and control cohorts, we did not provide evidence of abnormal intra-esophageal acid exposure or association of heartburn with reflux episodes. We had intended to perform pH-impedance monitoring in all cases but almost all patients declined this testing although it was recommended as part of their standard care. Further studies with larger numbers of patients with each of the commonly available IEE modalities and with histologic and pH-impedance monitoring in all patients would be useful to confirm our findings and provide greater precision of our estimates.

Another important limitation of this study--and most endoscopic studies--is that endoscopists were not blinded to the patient's clinical information (i.e., GERD symptoms vs. control). This may introduce bias in the endoscopist's assessment of findings using IEE. An optimal study design would be to have the esophageal examination with IEE performed by a second endoscopist who is blinded to the patient's clinical information and enters the endoscopy room only after the patient has been fully sedated.

Strengths of our study compared to many prior studies of IEE in GERD include the focus on patients with GERD symptoms who should receive upper endoscopy in clinical practice rather than a more general population of GERD patients and the use of additional criteria for GERD beyond merely requiring symptoms consistent with GERD

Our results suggest a possible algorithm to incorporate IEE modalities, available at no additional cost on current endoscopes, when patients with heartburn not responsive to anti-secretory therapy undergo upper endoscopy. Although IEE may not be sensitive enough to rule out non-erosive GERD, its specificity appears to be very high in our study and in prior studies of non-erosive GERD in which patients were responsive to PPI or PPI therapy was not mentioned⁸⁻¹⁰. For example, a finding of micro-erosions in our study (present in 57% of patients) had a specificity of 93%, while a finding of micro-erosions and vascularity at the squamo-columnar junction (present in 47% of patients) had a specificity of 98%. Two prior studies reported specificities of 100% for micro-erosion (no micro-erosions in control populations)^{8,9}, although a third study reported micro-erosions in 23% of controls¹⁰. Diagnostic tests that are highly specific are useful in ruling in a diagnosis.

In conclusion, our study provides evidence that IEE with NBI and i-Scan may be useful tools in the real-time diagnosis of non-erosive GERD when patients undergo upper endoscopy for heartburn unresponsive to anti-secretory therapy with PPIs. Whether the diagnostic performance of IEE findings are similar to those of pH-impedance monitoring and the relative utility of IEE vs. pH-impedance monitoring based on efficacy, cost, and patient acceptance require additional study.

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REFERENCES

1. Spechler SJ . Surgery for gastroesophageal reflux disease: esophageal impedance to progress? Clin Gastroenterol Hepatol. 2009;7:1264–5.19683073
2. Vakil NB , Traxler BM , Levine D . Symptom response and healing of erosive esophagitis with proton-pump inhibitors in patients with Helicobacter pylori infection. Am J Gastroenterol. 2004;99:1437–41.15307856

3. Sifrim D , Castell D , Dent J , Kahrilas PJ . Gastro-oesophageal reflux monitoring: review and consensus report on detection and definitions of acid, non-acid, and gas reflux. *Gut*. 2004;53:1024–31.15194656
4. Pritchett JM , Aslam M , Slaughter JC , Ness RM , Garrett CG , Vaezi MF . Efficacy of esophageal impedance/pH monitoring in patients with refractory gastroesophageal reflux disease, on and off therapy. *Clin Gastroenterol Hepatol*. 2009;7:743–8.19281866
5. Bredenoord AJ , Weusten BL , Timmer R , Conchillo JM , Smout AJ . Addition of esophageal impedance monitoring to pH monitoring increases the yield of symptom association analysis in patients off PPI therapy. *Am J Gastroenterol*. 2006;101:453–9.16464226
6. Subramanian V , Ragunath K . Advanced endoscopic imaging: a review of commercially available technologies. *Clin Gastroenterol Hepatol*. 2014;12:368–76.23811245
7. Lynch CR , Wani S , Rastogi A , et al. Effect of acid-suppressive therapy on narrow band imaging findings in gastroesophageal reflux disease: a pilot study. *Dis Esophagus*. 2013;26:124–9.22404535
8. Sharma P , Wani S , Bansal A , et al. A feasibility trial of narrow band imaging endoscopy in patients with gastroesophageal reflux disease. *Gastroenterology*. 2007;133:454–64.17681166
9. Lv J , Liu D , Ma SY , Zhang J . Investigation of relationships among gastroesophageal reflux disease subtypes using narrow band imaging magnifying endoscopy. *World J Gastroenterol*. 2013;19:8391–7.24363532
10. Fock KM , Teo EK , Ang TL , Tan JY , Law NM . The utility of narrow band imaging in improving the endoscopic diagnosis of gastroesophageal reflux disease. *Clin Gastroenterol Hepatol*. 2009;7:54–9.18852068
11. Kim MS , Choi SR , Roh MH , et al. Efficacy of i-Scan endoscopy in the diagnosis of gastroesophageal reflux disease with minimal change. *Clin Endosc*. 2011;44:27–32.22741109
12. Hoffman A , Basting N , Goetz M , et al. High-definition endoscopy with i-Scan and Lugol's solution for more precise detection of mucosal breaks in patients with reflux symptoms. *Endoscopy*. 2009;41:107–12.19214887
13. Kang HS , Hong SN , Kim YS , et al. The efficacy of i-Scan for detecting reflux esophagitis: a prospective randomized controlled trial. *Dis Esophagus*. 2013;26:204–11.23009249
14. Muthusamy VR , Lightdale JR , Acosta RD , et al. The role of endoscopy in the management of GERD. *Gastrointest Endosc* 2015;81:1305–10.25863867
15. Jones R , Junghard O , Dent J , et al. Development of the GerdQ, a tool for the diagnosis and management of gastro-esophageal reflux disease in primary care. *Aliment Pharmacol Ther*. 2009;30:1030–8.19737151
16. Jonasson C , Wernersson B , Hoff DAL , Hatlebakk JG . Validation of the GerdQ questionnaire for the diagnosis of gastro-oesophageal reflux disease. *Aliment Pharmacol Ther* 2013;37:565–72.
17. Savarino E , Zentilin P , Mastracci L , et al. Microscopic esophagitis distinguishes patients with non-erosive reflux disease from those with functional heartburn. *J Gastroenterol* 2013;48:473–482.23001252
18. Netinatsunton N , Sottisuporn J , Attasaranya S , et al. i-Scan detection of minimal change esophagitis in dyspeptic patients with or without Gastroesophageal Reflux disease. *BMC Gastroenterol* 2016;16:426762316

Table 1.

Selected characteristics of cases and controls

	Cases (n = 20)	Controls (n = 60)
Median age (range)	45 yrs (27–79)	42 yrs (54–84)
Female	2 (10%)	4 (7%)
Indications for endoscopy		
Heartburn not responding to PPI	20 (100%)	0
Anemia	0	19 (32%)
Diarrhea	0	18 (30%)
Variceal screening	0	12 (20%)
Abnormal imaging	0	7 (12%)
Weight loss	0	4 (7%)
Image-enhance endoscopic modality		
Narrow band imaging	11 (55%)	38 (63%)
i-SCAN	9 (45%)	22 (37%)

Table 2.

Findings with image-enhanced endoscopy in cases with non-erosive GERD and controls

Feature	Histologic GERD Cases (n = 20)	Controls (n = 60)	RR (95% CI)	p-value
Vascularity	13 (65%)	8 (13.3%)	4.9 (2.4–10.0)	< 0.0001
Micro-erosions	13 (65%)	4 (6.7%)	9.7 (3.6–26.5)	< 0.0001
Non-round pit pattern	19 (95%)	24 (40.0%)	2.4 (1.7–3.3)	< 0.0001
Vascularity + Micro-erosions	10 (50%)	1 (1.7%)	30.0 (4.1–220)	< 0.0001
Vascularity + Non-round pit pattern	13 (65%)	5 (8.3%)	7.8 (3.2–19.2)	< 0.0001
Micro-erosions + non-round pit pattern	13 (65%)	3 (5.0%)	13.0 (4.1–41.0)	< 0.0001
Vascularity + micro-erosions + non-round pit pattern	10 (50%)	1 (1.7%)	30.0 (4.1–220)	< 0.0001
Increased IPCLs	11 (55%)	6 (10.0%)	5.5 (2.3–13.0)	< 0.0001

GERD=gastroesophageal reflux disease; IPCL= intra-papillary capillary loop

Table 3.

Performance characteristics of image-enhanced endoscopic features for cases and controls

Feature	Sensitivity	Specificity	PPV	NPV
Vascularity	65.0%	86.7%	61.9%	88.1%
Micro-erosions	65.0%	93.3%	76.5%	88.9%
Non-round pit pattern	95.0%	60.0%	44.2%	97.3%
Vascularity + Micro-erosions	50.0%	98.3%	90.9%	85.5%
Vascularity + Non-round pit pattern	65.0%	91.7%	72.2%	88.7%
Micro-erosions + non-round pit pattern	65.0%	95.0%	81.3%	89.1%
Vascularity + micro-erosions + non-round pit pattern	50.0%	98.3%	90.9%	85.5%
Increased IPCLs	55.0%	90.0%	64.7%	85.7%

GERD=gastroesophageal reflux disease; IPCL= intra-papillary capillary loop

Table 4.

Findings with narrow-band imaging and i-SCAN in cases with non-erosive GERD and controls

Feature	Narrow-band imaging			i-SCAN		
	Cases (n=11)	Controls (N=38)	RR (95% CI)	Cases (n=9)	Controls (n=22)	RR (95% CI)
Vascularity	5 (45.5%)	6 (15.8%)	2.9 (1.1–7.7)	8 (88.9%)	2 (9.1%)	9.8 (2.6–37.4)
Micro-erosions	5 (45.5%)	3 (7.9%)	5.8 (1.6–20.4)	8 (88.9%)	1 (4.5%)	19.6 (2.8–135)
Non-round pit pattern	10 (90.9%)	15 (39.5%)	2.3 (1.5–3.6)	9 (100%)	9 (40.9%)	2.4 (1.5–4.0)
Increased IPCLs	8 (72.7%)	6 (15.8%)	4.6 (2.0–10.4)	2 (22.2%)	0	-----

IPCL=intra-papillary capillary loop