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Comparative acceptability of transnasal esophagoscopy and capsule esophagoscopy: a randomized controlled trial in a veteran population

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Abstract

Background—EGD screening for Barrett’s esophagus (BE) is costly with insufficient evidence to support its effectiveness.

Objective—To compare acceptance and tolerability of 2 novel unsedated office-based endoscopic screening techniques.

Design—Randomized block study design with allocation concealment.

Setting—Outpatient clinic setting at a Veteran Affairs (VA) medical center.

Patients—A total of 184 veterans with or without GERD symptoms.

Interventions—(1) Transnasal esophagoscopy (TNE); (2) Capsule esophagoscopy (ECE).

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Author contributions:

AC was responsible for conception and design of the study, interpretation of the data, drafting of the article and critical revision of the article for important intellectual content. BMA helped in acquisition of data, maintained the study database and provided administrative support. GAI performed the study procedures and critically revised the manuscript. AKC helped in acquisition of data, performed statistical analysis and critically revised the manuscript. KBG performed the procedures and helped with analysis and interpretation of the data. AH, RDP and SV performed the procedures and provided administrative and technical support. YFY was responsible for study concept and design, and critical revision of the manuscript. ALF was responsible for study concept and design, performed the procedures, critically revised the manuscript and supervised the conduct of the study. All authors have approved the final version of the article.

Main outcome measurements—(1) Acceptance of TNE and ECE; (2) Tolerability of TNE and ECE and effectiveness of BE screening.

Results—Esophageal screening was accepted by 184 of 1210 (15.2%) veterans. The majority were men (96%) and African American (58%) with a mean age of 58.9 (8.1) years. Five (5%) TNE subjects and 2 (2%) ECE subjects refused the assigned procedure after randomization ($p = 0.25$). Eleven (12.6%) patients randomized to TNE crossed the minimal clinically important threshold for overall procedure tolerability as opposed to none randomized to ECE ($p = 0.001$). Effectiveness of BE screening was not significantly different in both procedures (TNE vs. ECE = 3.2% vs. 5.4%, $p = 0.47$). Overall, BE was present in 8 of 75 (10.6%) whites, and 0 of 107 African American veterans ($p < 0.001$).

Limitations—General veteran population may not reflect the screening population for BE.

Conclusions—Despite a small proportion of veterans expressing interest in esophageal screening, both TNE and ECE were feasible in the outpatient clinic setting and accepted by >95% who did. Screening was only effective in Caucasians. Moderate differences in tolerability between TNE and ECE notwithstanding, cost considerations along with availability of equipment and trained personnel should guide the modality to be used for BE screening.

Keywords

Barrett's esophagus; Transnasal esophagoscopy; Capsule esophagoscopy; Veteran Affairs; Randomized controlled trial

Prospectively collected data indicate that the incidence of esophageal adenocarcinoma (EAC) has increased more than 3-fold in the past three decades.^{1–4} Over 10,000 cases are now diagnosed annually and the majority of these patients die within 5 years of diagnosis.^{4, 5}

Screening esophagogastroduodenoscopy (EGD) diagnoses Barrett's esophagus (BE), the premalignant precursor of EAC, in approximately 10% of patients with chronic gastroesophageal reflux disease (GERD).^{6–9} Subsequent surveillance is the current strategy for detecting dysplasia/cancer early and may result in improved survival.^{10–12} However, due to lack of high quality evidence supporting the efficacy of this strategy, endoscopic screening for BE in the general population is not recommended.^{9, 13} Thus, less than 5% of diagnosed EACs are in individuals with previously detected BE.¹⁴ Even if screening EGD were to be performed in every adult with chronic GERD, nearly 40% of EACs would still not be detected.^{15, 16} Detection of BE may be a particular problem among veterans with screening studies indicating a markedly high prevalence of BE not only in symptomatic but also in asymptomatic women veterans.^{17, 18} Hence, it has become essential to develop new screening strategies that use tests that are less expensive and less invasive than EGD, which can then be widely adopted in both the symptomatic and asymptomatic veteran populations.

Esophageal capsule endoscopy (ECE) and transnasal esophagoscopy (TNE) are 2 novel minimally invasive techniques proposed as alternatives to standard EGD for BE screening. Numerous prior studies comparing these 2 screening modalities individually to standard EGD have established that both ECE and TNE have a reasonable sensitivity for detecting

BE.^{19–26} These tests likely differ in terms of physician acceptance, patient acceptance, patient tolerability, and costs. Both ECE and TNE avoid the cost and adverse events associated with sedation and thereby could lend themselves well to larger population-based BE screenings in the outpatient clinic setting at Veteran Affairs (VA) medical centers. The primary aim of this trial was to compare acceptance, i.e. uptake of screening, when ECE and TNE are used as primary screening modalities within the adult veteran population, a predominantly male population that appears to be at increased risk for BE. The secondary aims were to compare tolerability and evaluate the overall yield of BE screening in a previously unscreened population.

METHODS

Participants

Adult veterans between the ages of 45 and 85 years, without a prior EGD in the past 10 years, and with no contraindications to ECE or TNE (history of recurrent epistaxis), with or without symptoms of GERD were eligible to participate. Exclusion criteria were altered nasopharyngeal anatomy, allergy to lidocaine derivatives, bleeding diathesis, prolonged prothrombin time, known swallowing disorders, having a cardiac pacemaker or other electromechanical implants, suspected gastrointestinal obstruction, strictures, or fistulas based on clinical picture. Eligible adult subjects seen in the primary care clinics or scheduled for primary care visit were recruited either by mail or by a flyer to participate in a new unsedated test to screen for Barrett's esophagus. The rationale for BE screening was explained by a study coordinator before randomization with the study subject given the option of forgoing the allocated screening procedure after randomization. The study was approved by the Institutional Review Board at the Louis Stokes Cleveland VA hospital where the study was conducted.

We invited 1210 eligible patients to participate in the study and 184 (15.2%) agreed (Figure 1). Eligible participants who agreed to screening were first randomized to either TNE or ECE in a 1:1 fashion using a computer-generated permuted-block randomization with variable blocks of 4 to 6. Allocation was concealed using serially numbered sealed opaque envelopes. A study coordinator managed the informed consent and randomization process. Outcome adjudication (i.e. biopsy confirmation of BE by a pathologist) was blinded. Subjects who were randomized received an incentive of \$20 as a token of appreciation regardless of whether they agreed to have the procedure or not.

Procedures

TNE—TNE was performed with the disposable sheath TNE-5000 digital esophagoscope (Vision Sciences, Inc., Orangeburg, NY) in an outpatient clinic setting. TNE was performed on subjects in the sitting position by an attending endoscopist or a physician extender trained to perform TNE.²⁷ The nasal passage with the wider patency was selected and anesthetized with an atomizer using a 1:1 mixture of 2% lidocaine and 1% neosynephrine instilled deep into the selected nostril over a 2-minute period. A 3-second instillation of aerosolized 14% benzocaine into the oropharynx just before intubation was also used in some patients. When

the nasal passage did not permit passage, the esophagoscopy was performed per orally using topical pharyngeal anesthesia.

ECE—ECE was performed with the Pillcam ESO2 capsule endoscopy system (Given Imaging, Inc., Yoqneam, Israel) using a real time video imager. The patient ingested the capsule using the standard simplified ingestion protocol.²⁸ In this protocol, the patient practices sips of water then drinks 100 mL of water to clear saliva. Lying in the right lateral decubitus position the patient then ingests the activated video capsule with a sip (5 - 10 mL) of water. After remaining in the right lateral position, they drink another sip (15 mL) of water every 30 seconds for 7 minutes. After 7 minutes, the patient sits upright and drinks a sip (15 mL) of water. Real-time visualization allowed the examiner to determine the entry/passage of the capsule into the stomach. Videotapes of the ECE examination were reviewed both by a physician extender trained in ECE and by a gastroenterology attending with expertise in capsule endoscopy.

Outcomes

Acceptance and Tolerability—Before the screening examination, subjects filled out a validated study questionnaire that collected data on demographics, family history (of GERD, BE and esophageal cancer) and exposures.²² After the procedure, patients filled out a tolerability questionnaire that has been used in prior studies to rate their experience of pain, gagging, choking and overall tolerability on a 10-point Likert scale (1 = minimal and 10 = severe).²⁹ A cut-off of 3 on the scale of 10 was chosen as the minimal clinically important threshold for tolerability of TNE.²² Because this scale has not been previously tested in patients undergoing capsule endoscopy, we conducted our analysis using the same threshold score of 3 for both TNE and ECE. Patients who refused participation after randomization were asked to fill out a “non-completion” questionnaire to ascertain reasons for non-completion.

Yield of Screening—Findings on TNE or ECE were noted on a study form that collected information on the ZAP classification³⁰ (to determine the need for biopsy based on endoscopic appearance of the squamocolumnar junction), Los Angeles classification of GERD,³¹ length of suspected BE (cm), Prague classification of BE,³² and size of hiatal hernia (cm). Because ECE cannot measure the length of BE, data entries regarding length were left blank when ECE was performed. Subjects with suspected BE (ZAP grade 2 or higher) or other findings (mass, ulcer, etc.) that required biopsy were referred for standard sedated EGD. The presence of biopsy-confirmed BE was recorded after histologic examination at subsequent EGD.

Sample Size—We hypothesized that 20% of subjects who are randomized to TNE screening and 5% of subjects randomized to ECE screening will find the procedure unacceptable when the procedure is explained to them. The estimated sample size to detect differences in unacceptability between ECE and TNE with a power of 0.8 at a significance level of 0.05 was 176 study subjects.

Analysis—Descriptive statistics were generated for demographic variables, exposures and, diagnostic yield. Data on current and past use of acid suppression (proton pump inhibitors or H2 blockers) were obtained from the patient's medical chart and along with reflux symptoms obtained from the GERD questionnaire, a composite variable was created to classify subjects as symptomatic (defined as someone who either had reflux symptoms or was on acid suppression medication) or asymptomatic (defined as someone with no reflux symptoms and never on acid suppression medication). Per-protocol analysis was performed to calculate mean scores for procedure tolerability. Student t-tests were used to compare tolerability (pain, choking, gagging) of TNE with ECE. Chi-square tests were performed for categorical variables and t-tests for continuous variables to determine associations with acceptance comparing ECE and TNE. Using the intention-to-treat (ITT) approach, TNE was compared with ECE for screening effectiveness (i.e. BE on procedure and BE on biopsy). A final diagnosis of BE required pathological confirmation of intestinal metaplasia in columnar epithelium. Non-completers, equipment failures and patients who refused the procedure after randomization were considered failures for the purpose of ITT analysis. Analysis was performed using SPSS v. 21 (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.)

RESULTS

Study Subjects

Of 184 subjects who consented and were randomized to undergo BE screening, 7 people withdrew post-randomization (5 in TNE and 2 in ECE, $p = 0.25$). There was 1 equipment failure where the capsule failed to transmit data to the receiver and 1 TNE procedure was stopped midway due to procedure related pain.

The mean age of the participants was 59 (8) years. Baseline characteristics including patient demographics, use of acid suppressing medications and smoking exposure is shown in Table 1. Twenty-three (25%) subjects who underwent TNE and 20 (21.7%) subjects who underwent ECE were totally asymptomatic (i.e., reported no GERD symptoms on the questionnaire, were not currently on acid suppression, and had no history of acid suppression therapy).

Acceptance

Ninety-two study subjects were randomized to TNE screening and 92 subjects were randomized to ECE screening. After the assigned screening procedure was explained to study subjects, 87 (94.5 %) of those randomized to TNE and 90 (97.87%) randomized to ECE screening accepted their assigned procedures respectively ($p = 0.25$ for difference in acceptance).

Procedure tolerability

Study subjects who underwent the assigned screening procedure rated the severity of symptoms associated with the procedure. One patient out of 92 subjects assigned to TNE required per-oral esophagoscopy as the endoscope could not be passed transnasally and 1 subject refused further examination because of pain related to transnasal passage. A

significantly greater proportion of patients randomized to TNE reported anxiety before and during the procedure (Table 2). Patients who underwent TNE crossed the minimally clinically important threshold scores for pain, choking and gagging significantly more often than those randomized to ECE (Table 2). Overall, 12.6% of subjects randomized to TNE found it intolerable compared with none of the ECE group.

Twenty eight TNE procedures were performed by physician extenders. There were no significant differences in TNE procedures performed by GI attendings vs. physician extenders in terms of patient reported pain (1.81 vs. 2.25, $p = 0.26$), choking (1.80 vs. 1.37, $p = 0.16$) and overall tolerability (1.67 vs. 2.56, $p = 0.10$).

Yield of Screening

TNE and ECE procedure findings including hiatal hernia and esophagitis are detailed in Table 3. There were 19 patients with suspected BE and 1 patient with an esophageal mass who were referred for sedated EGD. BE was confirmed by biopsy in 8 subjects (TNE vs. ECE = 3/87 vs. 5/90, $p = 0.49$) and was ruled out in 11 subjects. False positives were not significantly different between TNE (7/10) and ECE (4/9), $p = 0.37$. The mass discovered in an African American patient who had GERD symptoms without dysphagia or weight loss proved to be an adenocarcinoma of the gastroesophageal junction and the patient was referred to surgical therapy. BE was not noted on this examination. Of note, the patient had been seen in the primary care clinic in the preceding year for GERD symptoms and had not been recommended for EGD. BE was identified in 8 of 75 (10.6%) whites and 0 of 107 (0%) African Americans, $p < 0.001$. All biopsy-confirmed BE cases were men with a mean age of 56 (range, 39 to 69) years. Among the 8 identified with biopsy-confirmed BE, 4 subjects were currently on a proton pump inhibitor (PPI) and 4 were not. Two of the 4 who were not currently on acid suppression medication had a history of acid suppression whereas 1 patient had symptoms of GERD (i.e., had no current or past use of acid suppression medication but reported GERD symptoms on the questionnaire). One patient out of the 8 confirmed with BE did not report any reflux symptoms on the GERD questionnaire nor was he on acid suppression medication around the time of his procedure or in the past. All 8 subjects (3 TNE patients and 5 ECE patients) diagnosed with BE were current smokers.

DISCUSSION

The major limitations of BE screening strategies that recommend sedated EGD in patients with refractory GERD symptoms or alarm symptoms are clearly evident.⁹ This strategy fails to detect BE in asymptomatic subjects. It also fails to detect BE in patients whose symptoms are well controlled with either over the counter medications or physician prescribed therapies. Ablative non-surgical therapies that have been developed for BE with high grade dysplasia over the past decade^{33, 34} will have little impact, and the 5 year survival for EACs will remain a dismal 19%⁵ unless we develop more effective programs for identifying BE in the general adult population. This could be particularly true at VA medical centers where the reported prevalence of BE in symptomatic and asymptomatic veterans may lead to a higher incidence of cancer.^{17, 18} This study demonstrates that TNE and ECE are equally accepted

as primary screening tests and could be considered for BE screening in the outpatient clinic setting at VA medical centers.

Only a small proportion (approximately 15% of contacted subjects) of subjects who were approached expressed interest in esophageal screening even when TNE or ECE was offered directly to primary care patients. This low uptake could be due to a lack of knowledge among veterans regarding BE, lack of motivation regarding screening in general and/or a reluctance to undergo procedures as part of a research study. Neither ECE nor TNE will be successful as screening tools unless effective educational programs are developed to increase awareness of BE among primary care physicians and the populace.

The population prevalence of BE is low, estimated to be approximately 1 - 3% in the adult population.³⁵⁻³⁷ Therefore, a study comparing the effectiveness of ECE and TNE in diagnosing BE within the population would require a prohibitively large sample size. The effectiveness of these 2 novel unsedated procedures for BE screening, ECE and TNE, depends on a composite of different factors – sensitivity for detecting BE, adverse event rates, costs, tolerability, and acceptance.³⁸ Of these factors, we felt that acceptance of a primary screening test was the most significant outcome to compare in this study. Studies that have compared either ECE or TNE with standard EGD demonstrate that ECE has a sensitivity of about 80% for detecting BE whereas TNE is nearly equivalent to EGD.^{19, 21, 24, 38-40} The lower sensitivity and higher cost of ECE will be offset if ECE is found to be much more acceptable than TNE. Both procedures appear to have minimal adverse event rates because they avoid sedation and are quite well tolerated when trained personnel perform them. TNE causes mild discomfort but 70% to 95% of patients who undergo the procedure are willing to repeat it.^{19, 21, 38, 39, 41} Acceptance has proven to be the major barrier preventing the widespread adoption of TNE in the United States,^{29, 42} but has never been assessed when TNE is routinely offered as a primary screening test to an adult veteran population. In this study, veterans who agreed to be screened accepted both TNE and ECE indicating that either technique could be implemented in a screening program.

We deliberately chose to offer screening to adult veterans who had not previously been screened regardless of gender, race, or GERD symptoms. Previous studies have reported a high yield of BE in the symptomatic as well as asymptomatic veteran population.^{17, 18} However, our study found a lower yield in our VA population when subjects were screened with ECE or TNE. The lower yield may be related to a rigorous definition of BE where subjects with irregular Z-lines were not referred for endoscopy or biopsy, perhaps a lower sensitivity for ECE or TNE than sedated EGD, and institutional differences in veteran populations. We feel it is important to restrict the definition of BE such that patients diagnosed to have BE have a risk of progression to cancer that justifies subsequent surveillance. Our study also found that TNE or ECE screening had a much higher yield for BE in whites than African Americans. Even though we identified an asymptomatic cancer of the gastric cardia in an African American veteran who had no discernible BE, from a population screening perspective, our study would suggest that screening should be limited to white men.

One of the biggest challenges in developing BE screening is the fact that 40% of patients with cancer have no prior GERD symptoms.^{15, 16} Approximately one-fifth of the patients who accepted screening in this study were truly asymptomatic. We also identified BE in 1 subject who was completely asymptomatic suggesting these methods can be effective in identifying asymptomatic BE if they can be implemented in the asymptomatic adult population. However, strategies for increasing recruitment of these subjects will need to be developed to impact on outcomes for the asymptomatic BE population.

Subjects who agreed to undergo esophageal screening were more anxious about undergoing TNE than ECE. As expected, a greater proportion of subjects undergoing TNE reported pain, choking, and gagging compared with those undergoing ECE. All subjects found ECE to be tolerable whereas over one tenth of the subjects randomized to TNE found it intolerable. Tolerability of TNE did not differ when performed by attending gastroenterologists or physician extenders (nurse practitioner or physician assistant) trained in TNE.²⁷ The use of physician extenders for screening would lower the costs of screening and would enable the performance of screening in the primary care setting.

The adoption of ECE has been limited by its cost. Currently, the capsules for ECE cost ca. \$500. However, costs of new technologies often come down rapidly once the technology becomes widely available. The assessment of cost effectiveness also requires long-term follow-up of the screened population to determine the risk of cancer. Hypothetical cost utility models that incorporate the findings of this study will need to be developed to help determine optimal strategies to recommend BE screening.

The strengths of this study were the rigorous screening of primary care patients for eligibility, the randomized design, the use of questionnaires that had been validated or previously tested, and the endoscopic follow-up with biopsies in patients suspected to have BE. We found that our GERD questionnaire based on the previously validated GERQ⁴³ did not collect symptom information accurately in all subjects, likely because many subjects were already on PPIs. Thus, in our analysis, past or current use of acid suppressive medications was considered a secondary proxy for GERD symptoms. We realize that this may over-estimate GERD as acid suppressive medications can be used for peptic symptoms or under-estimate GERD as not all patients with GERD will take H2-blockers or PPIs. Nevertheless, we feel that this second proxy measurement gave us a better estimate of the proportion of our subjects who were asymptomatic rather than relying solely the GERD symptoms questionnaire that we administered.

The study had several limitations. Subjects in this study were not referred for standard sedated EGD when only irregular Z lines were present on screening, thus potentially missing intestinal metaplasia at the gastroesophageal junction. However, patients with intestinal metaplasia identified on biopsy specimens obtained from an irregular Z line have a low risk of cancer progression and we opine that such people should not be included in surveillance programs. The study design could have influenced the results. A crossover trial design would have been better for comparing tolerability, but such a design would not have let us compare the acceptance of TNE and ECE as single primary screening tests. Subjects may have elected not to participate in screening because they were reluctant to participate in a

research study. Nearly 85% of subjects who were contacted refused and we were unable to determine the reasons why they did not accept screening. Finally, because not everyone who underwent TNE or ECE screening underwent the current criterion standard, i.e. sedated EGD, the sensitivity of TNE and ECE could not be assessed. Thus, this study may have underestimated the yield of BE in the screened veteran population.

In summary, we found that either TNE or ECE is acceptable to most primary care patients who are interested in being screened for BE. Either modality can identify BE in patients with or without GERD symptoms but the large majority of patients interested in screening have symptoms. TNE is moderately less tolerable than ECE. BE is identified largely in adult white males and any screening program that is developed may need to be restricted to this population. Costs and availability of equipment and trained personnel will guide whether TNE or ECE are actually used for screening in this population. Given that ECE is currently more expensive than TNE, one strategy could be to perform TNE in those subjects who are not anxious and use ECE selectively for anxious subjects or those who cannot tolerate TNE.

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Acronyms

EGD	Esophagogastroduodenoscopy
BE	Barrett's esophagus
EAC	Esophageal adenocarcinoma
TNE	Transnasal esophagoscopy
ECE	Capsule esophagoscopy
GERD	Gastroesophageal reflux disease
VA	Veteran Affairs
ZAP	Z-line appearance
ITT	Intention-to-treat
PPI	Proton pump inhibitor

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Take-home message

- Either transnasal esophagoscopy or capsule esophagoscopy could be used for population-based screening for Barrett's esophagus in the primary care setting.
- Although feasible and acceptable to patients, a successful screening program using these new strategies will require an increased uptake of esophageal screening in primary care physicians and patients. Esophageal screening may only be effective in whites.

Figure 1.
Flow chart of patient randomization to transnasal esophagoscopy and capsule esophagoscopy.

Table 1

Demographic characteristics and exposure history of patients randomized to TNE or ECE (n = 184)

	TNE (n = 92)	ECE (n = 92)	p-value
Mean Age ¹ (SD)	58.8 (8.3)	59 (8)	0.81
Gender			0.70
Male	88 (95.6%)	89 (96.7%)	
Female	4 (4.4%)	3 (3.3%)	
Race			0.35
White	38 (41.3%)	37 (40.2%)	
Black or African American	52 (56.6%)	55 (59.8%)	
Hispanic or Latino	2 (2.1%)	0	
Mean BMI ¹ (SD)	31.25 (7.66)	31.38 (6.98)	0.90
GERD ²			0.93
No symptoms	47 (51%)	46 (50%)	
Mild	21 (23%)	25 (27.2%)	
Moderate	7 (7.6%)	8 (8.7%)	
Severe	10 (11%)	9 (9.8%)	
GERD duration			0.22
<1 year	13 (14.1%)	24 (26.1%)	
1 - 3 years	18 (20%)	14 (15.2%)	
3 - 5 years	11 (12%)	7 (7.6%)	
5 - 10 years	5 (5.4%)	9 (9.8%)	
>10 years	10 (10.9%)	15 (16.3%)	
Current acid suppression ³	38 (41.3%)	47 (51%)	0.18
Past acid suppression ⁴	56 (61%)	60 (65.2%)	0.54
Smoking ⁵	75 (81.5%)	72 (78.2%)	0.58

¹ Age and BMI are presented as means and SD; rest are number and percent² Obtained from GERD symptom questionnaire with 0 = no symptoms and 5 = severe symptoms³ Defined as use of acid suppression medication during the time of or within 7 days of the screening procedure⁴ Defined as past use of acid suppression medication, but not within 7 days of the screening procedure⁵ A smoker was defined as someone who has smoked at least 1 cigarette within 30 days of the date of the procedure

Table 2

Patients crossing the minimal clinically important difference for procedure tolerability (n = 177)

	TNE (n = 87)*	ECE (n = 90)*	p-value
Anxiety, nervousness, or worry before the procedure	33 (38%)	15 (17%)	0.001
Anxiety, nervousness, or worry during the procedure	29 (33%)	14 (16%)	0.006
Pain	19 (22%)	1 (1.1%)	<0.001
Gagging or retching	26 (30%)	3 (3.3%)	<0.001
Choking	10 (11.5%)	0 (0%)	0.002
Overall intolerability	11 (12.6%)	0 (0%)	0.001

* Minimal clinically important threshold for TNE and ECE = 3 on a scale from 0 to 10

Table 3

Yield of screening: procedure findings (n = 175)

	TNE (n = 85)	ECE (n = 90)
Hiatal hernia	16 (18.8%)	5 (5.7%)
Length of hiatal hernia ¹	1.8 (0.7)	1.5 (0.6)
Esophagitis		
Grade A	18 (56.3%)	4 (80%)
Grade B	13 (40.6%)	0
Grade C	1 (3.1%)	0
Grade D	0	1 (20%)
Complete visualization of Z-Line	74 (87.1%)	80 (90.9%)
ZAP grade of Z-line		
Grade 0	58 (77.3%)	61 (73.5)
Grade 1	8 (10.7%)	16 (19.3)
Grade 2	8 (10.7%)	4 (4.8)
Grade 3	1 (1.3%)	2 (2.4)

¹ Data presented are means and SD