Web-Based Educational Intervention for Patients With Uninvestigated Dyspepsia Referred for Upper Gastrointestinal Tract Endoscopy

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Web-Based Educational Intervention for Patients With Uninvestigated Dyspepsia Referred for Upper Gastrointestinal Tract Endoscopy
A Randomized Clinical Trial

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IMPORTANCE Diagnostic yield of upper gastrointestinal (GI) tract endoscopy for uninvestigated dyspepsia is low, and its clinical implications are limited. There is an unmet need for better strategies to reduce the volume of upper GI tract endoscopic procedures for dyspepsia.

OBJECTIVE To study the effectiveness of a web-based educational intervention as a tool to reduce upper GI tract endoscopy in uninvestigated dyspepsia.

DESIGN, SETTING, AND PARTICIPANTS This open-label, multicenter, randomized clinical trial enrolled participants between November 1, 2017, and March 31, 2019, with follow-up 52 weeks after randomization, at 4 teaching hospitals in the Netherlands. Participants included patients with uninvestigated dyspeptic symptoms who were referred for upper GI tract endoscopy by their general health care clinician without prior consultation of a gastroenterologist. A total of 119 patients, aged 18 to 69 years, were included. Patients were excluded if any of the following red flag symptoms were present: (indirect) signs of upper GI tract hemorrhage (hematemesis, melena, hematochezia, or anemia), unintentional weight loss of 5% or higher of normal body weight during a period of 6 to 12 months, persistent vomiting, dysphagia, or jaundice.

INTERVENTIONS Patients were randomly assigned (1:1) to education (intervention) or upper GI tract endoscopy (control). Education consisted of a self-managed web-based educational intervention, containing information on gastric function, dyspepsia, and upper GI tract endoscopy.

MAIN OUTCOMES AND MEASURES Difference in the proportion of upper GI tract endoscopy procedures between those who received access to the web-based educational intervention and those who did not at 12 weeks and 52 weeks after randomization, analyzed in the intention-to-treat population. Secondary outcomes included quality of life (Nepean Dyspepsia Index) and symptom severity (Patient Assessment of Gastrointestinal Disorders Symptom Severity Index) measured at baseline and 12 weeks.

RESULTS Of 119 patients included (median age, 48 years [interquartile range, 37-56 years]; 48 men [40%]), 62 were randomized to web-based education (intervention) and 57 to upper GI tract endoscopy (control). Significantly fewer patients compared with controls underwent upper GI tract endoscopy after using the web-based educational intervention: 24 (39%) vs 47 (82%) (relative risk, 0.46; 95% CI, 0.33-0.64; $P < .001$). Symptom severity and quality of life improved equivalently in both groups. One additional patient in the intervention group required upper GI tract endoscopy during follow-up.

CONCLUSIONS AND RELEVANCE Findings of this study indicate that web-based patient education is an effective tool to decrease the need for upper GI tract endoscopy in uninvestigated dyspepsia.

TRIAL REGISTRATION ClinicalTrials.gov Identifier: NCT03205319

Visual Abstract

Supplemental content

CME Quiz at jamacmelookup.com and CME Questions page 887

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Upper gastrointestinal (GI) tract endoscopy is subject to overuse. A third of upper GI tract endoscopic procedures are performed for dyspeptic symptoms.[1,2] The yield for this indication is low, and the procedure is unlikely to change the clinical treatment of patients with dyspepsia. Esophageal or gastric cancer is detected in less than 1% of all upper GI tract endoscopic procedures.[3] There is potential harm in exposing patients to low-value procedures.[4] Hospital-acquired complications of upper GI tract endoscopy are reported in 0.1%, and costs to detect 1 case of cancer in patients with uninvestigated dyspepsia are considerable.[5] As a result, international guidelines advocate a conservative approach to the use of upper GI tract endoscopy for dyspepsia.[6,7]

Initiatives to reduce the use of upper GI tract endoscopy for dyspepsia through guideline recommendations have led to better patient selection.[8,9] However, lack of comprehensive patient information, absence of adequate treatment options, and misconceptions about health care among patients contribute to continued inappropriate use of health care.[10] This concept is supported by a qualitative study among dyspeptic patients which revealed that 70% think that upper GI tract endoscopy is essential in the workup of dyspepsia, and 20% believe that dyspepsia will ultimately lead to cancer.[11] Shared decision-making is the cornerstone of current practice, and engaging patients in endoscopy-reducing strategies should be encouraged.

Education positively influences patients' self-management and health judgment. A large randomized trial showed that educating hospitalized patients prior to discharge reduced readmission rates.[12] A cohort study found that self-managed education was associated with better bowel preparation for colonoscopy.[13,14]

There is a paucity of evidence on patient education as an aid in the reduction of upper GI tract endoscopic procedures in dyspepsia while maintaining quality of life. To this end, we developed a web-based educational intervention that informs patients with dyspepsia about causes, consequences, and self-management of dyspepsia. We then assessed whether the use of this web-based educational tool resulted in deferral from an endoscopic procedure among patients referred for upper GI tract endoscopy by their general health care professional without prior consultation of a gastroenterologist.

Key Points

Question Can dedicated health education for patients with uninvestigated dyspepsia reduce the number of upper gastrointestinal tract endoscopic procedures?

Findings This open-label, multicenter, clinical trial randomized 119 patients between health education or usual care and found that educating patients on dyspepsia greatly and sustainably decreased the number of upper gastrointestinal tract endoscopic procedures (39% vs 82%).

Meaning Educating patients with uninvestigated dyspepsia effectively decreases the need for upper gastrointestinal tract endoscopic procedures.

Methods

Study Overview

This open-label, multicenter, randomized clinical trial enrolled participants between November 1, 2017, and March 31, 2019, across 4 teaching hospitals situated in 3 provinces of the Netherlands (trial protocol in Supplement 1). The study was part of a national program initiated by the Dutch Ministry of Health, Welfare and Sport and was conducted in accordance with the Declaration of Helsinki[15] and Good Clinical Practice guidelines. Study data were collected and stored using the validated and Good Clinical Practice guideline–approved data management system Castor EDC (Ciwit BV). We followed the Consolidated Standards of Reporting Trials (CONSORT) reporting guideline.[16] The trial is registered at ClinicalTrials.gov.[17] The study protocol was approved by the institutional review board of the Radboud University Medical Center, Nijmegen, the Arnhem-Nijmegen medical ethics committee, and local study committees of participating centers. Written informed consent was obtained from all participants at the outpatient clinic of each participating center by the researchers. No one received compensation or was offered any incentive for participating in this study.

Participants

Participants were selected using clinician referral letters for upper GI tract endoscopy without prior consultation of a gastroenterologist. In the Netherlands, this route excluding consultation of a gastroenterologist is a routine procedure, enabling fast access to upper GI tract endoscopy. All patients aged 18 to 69 years referred for dyspepsia were eligible for inclusion and received detailed patient information concerning the study rationale and procedures. Dyspepsia was defined as any symptom referable to the upper gastrointestinal tract that was present for a least 4 weeks and including upper abdominal pain or discomfort, nausea, or vomiting.[18] We excluded patients having any first or second degree relative with a history of upper GI tract malignant neoplasm or having language or psychosocial barriers potentially impairing full comprehension of questionnaires and study procedures. Also excluded were patients presenting with red flag symptoms, defined as direct or indirect signs of upper GI tract hemorrhage (hematemesis, melena, hematochezia, or anemia), unintentional weight loss of 5% or higher of normal body weight during a period of 6 to 12 months, persistent vomiting, dysphagia, or jaundice. No selection was made based on nonsteroidal anti-inflammatory drug use or *Helicobacter pylori* status. Because *H pylori* prevalence is below 20% in the Netherlands, we did not expect this selection criteria to be of significant influence.[19] Sample size calculation is included in the eMethods in Supplement 2.

Intervention and Study Procedures

The intervention consisted of a web-based educational intervention that was specifically developed for this study. The basis for the content was preliminary research of unmet needs in dyspepsia management through focus groups with patients and clinicians and research of literature and national

guidelines. A short description of the web-based educational tool is published in the eMethods in Supplement 2, and the development process and content validity is described and visually presented in detail elsewhere.[20]

Participants were randomized in a 1:1 ratio (eMethods in Supplement 2) to either education as an alternative to upper GI tract endoscopy (intervention) or upper GI tract endoscopy alone (control). Those participants allocated to the intervention received a link to the web-based tool and were encouraged to complete the educational program at home before making an appointment for upper GI tract endoscopy. Participants in the control group did not receive this link or access to the educational tool before making an appointment for upper GI tract endoscopy. During the follow-up period, participants in both groups were free to make an appointment for upper GI tract endoscopy at any time and for any reason. We did not restrict the use of drugs or alternative treatment, including herbal supplements.[21] Diagnostic upper GI tract endoscopy was performed according to local standards. Biopsy specimens for microbiologic or histologic evaluation were obtained at the discretion of the individual endoscopist and analyzed by local microbiologists and pathologists. The collected baseline variables are given in the eMethods in Supplement 2.

Outcomes

The primary outcome was the proportion of patients who underwent upper GI tract endoscopy within 12 weeks after randomization. Data on upper GI tract endoscopy procedures were collected by the researchers (including J.J.) from hospital electronic health records and cross-checked by contacting the patient's clinician because clinicians have a key role in coordinating primary and secondary care for patients and therefore have an accurate overview of the health care use of patients.[22] In case of worsening symptoms or a patient's strong preference for upper GI tract endoscopy in the course of the trial, patients were scheduled for upper GI tract endoscopy.

Secondary outcomes were the proportion of patients in the intervention group that underwent upper GI tract endoscopy during follow-up at 52 weeks after randomization. In addition, change of symptom severity and quality of life was measured using 2 validated questionnaires administered at baseline and 12 weeks after randomization: (1) Patient Assessment of Gastrointestinal Symptom Severity Index and (2) Nepean Dyspepsia Index. The mean (95% CI) total score was calculated for both questionnaires. For the Patient Assessment of Gastrointestinal Symptom Severity Index, scores above 0.3 were considered clinically relevant, according to the minimal clinical important difference (ie, the minimal difference needed to be considered clinically relevant) set by the questionnaire developers.[23] Health anxiety level was measured at baseline and 12 weeks after randomization using the Short Health Anxiety Inventory.

Upper GI tract endoscopy results were categorized into 3 categories: no abnormality, not a clinically relevant finding, and a clinically relevant finding.[3] Not clinically relevant findings included all findings that did not require further investigation or treatment and included nonerosive gastritis (histologically proven), hiatal hernia, and reflux esophagitis grade A (according to the Los Angeles classification). Clinically relevant findings included Barrett esophagus, reflux esophagitis grade B, C, or D, *H pylori* gastritis, gastric ulcer, and malignant neoplasm. If more than 1 abnormality was found on upper GI tract endoscopy, the most significant result was reported.

Statistical Analysis

For the primary end point, we calculated the proportion of patients who underwent (or intended to undergo) upper GI tract endoscopy within 12 weeks and compared proportions using a χ^2 test on an intention-to-treat basis. Relative risk with 95% CI and number needed to educate to prevent 1 upper GI tract endoscopy were derived. Data were analyzed according to an intention-to-treat principle. Normally distributed variables are presented as means with SDs; and nonnormally distributed variables, as medians with interquartile ranges. Data were compared using *t* tests or Mann-Whitney tests, respectively. To compare change over time in questionnaire data between intervention and control, we used a multilevel model with baseline and follow-up data as outcomes and assessed time by randomization group interaction. Correlations were calculated using Pearson *r* in case of normally distributed data and Spearman rank correlation for nonnormally distributed data. All analyses were performed with IBM SPSS Statistics, version 25.0 (Armonk). All tests were 2-sided, and owing to the revised sample size, $P < .048$ was considered statistically significant.

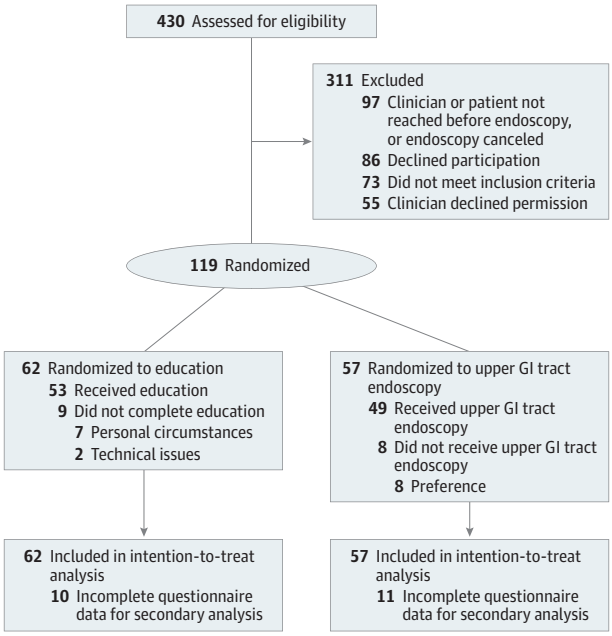
Results

A total of 430 patients met the eligibility criteria, of which participation was declined in 141 cases by either the patient (n = 86) or clinician (n = 55) (**Figure 1**). Ninety-seven patients could not be contacted before an appointment for upper GI tract endoscopy was made. The included 119 patients were randomly assigned either to receive access to the web-based educational intervention (n = 62) or to the control group (n = 57). The median age was 48 years (interquartile range, 37-56 years), and 48 participants (40%) were men (**Table 1**).[24,25] At baseline, 88 participants (74%) used acid-suppressive drugs, and 7 participants (6%) sporadically used nonsteroidal anti-inflammatory drugs. The mean (SD) duration of acid-suppression use was 80 (26) weeks. Twenty-eight patients (24%) previously underwent upper GI endoscopy, and 67 patients (56%) were tested for the presence of *H pylori*. Categorizing symptoms according to the Rome IV criteria for functional dyspepsia indicated that 67 patients (56%) fulfilled criteria for functional dyspepsia.[25] The mean symptom severity score was 1.57 (95% CI, 1.39-1.74); the dyspepsia-related quality of life score was 1.32 (95% CI, 1.16-1.48); and the health anxiety score was 0.84 (95% CI, 0.74-0.95). No significant differences in baseline variables were apparent between groups.

Primary End Point

Significantly fewer patients compared with controls underwent upper GI tract endoscopy after using the web-based educational intervention: 24 (39%) vs 47 (82%) (relative risk, 0.46; 95% CI, 0.33-0.64; $P < .001$) (**Figure 2**). The educational

Figure 1. Study Flow Diagram



GI represents gastrointestinal.

program was not completed by 9 patients (15%) in the intervention group, 5 of whom subsequently underwent upper GI tract endoscopy. Ten patients (18%) in the control group refrained from undergoing upper GI tract endoscopy. The number needed to educate to prevent 1 upper GI tract endoscopy was 5. No patient developed red flag symptoms during the study. None of the canceled upper GI tract endoscopic procedures concerned "no-shows." Two patients in the control group intended to undergo upper GI tract endoscopy, but repeatedly canceled the appointment for personal reasons. Both were counted toward upper GI tract endoscopy in our intention-to-treat analysis at 12 weeks.

Secondary Outcomes

One patient in the intervention group received an upper GI tract endoscopy within 52 weeks after randomization after initially declining at the primary end point. Patient-reported measures at baseline and follow-up are reported in **Table 2.** Equal improvement of symptom severity and quality of life were seen in both groups during follow-up. Health anxiety improved in the intervention group (mean, 0.18; 95% CI, 0.05-0.31; $P = 0.008$), but not in the control group (mean, 0.08; 95% CI, −0.00 to 0.16; $P = .05$). Undergoing subsequent upper GI tract endoscopy after education was not explained by higher levels of health anxiety ($r = 0.022$, $P = .83$, n = 24).

The results of 71 upper GI tract endoscopic procedures performed in both groups are shown in **Table 3**. There were no clinically relevant findings in 58 procedures (82%). Endoscopic findings did not differ between patients with or without PPI use. In 25 upper GI tract endoscopic procedures, 1 or more biopsy specimens were obtained, of which 20 were target biopsy specimens from endoscopically identified lesions, and 5 were obtained "at random." The randomly obtained specimens showed no coincidental findings. The results from the 20 remaining biopsy specimens are given in Table 3. None showed celiac disease, and no malignant neoplasm was detected.

Discussion

This multicenter randomized clinical trial examined a novel strategy to reduce upper GI tract endoscopy use in dyspepsia. The results showed that a web-based educational intervention successfully decreased the number of gastroscopic procedures performed in the absence of red flag symptoms. The decrease in the number of procedures was sustained for at least 52 weeks after randomization. We also found that patient education mitigated symptoms and improved the quality of life equally compared with undergoing upper GI tract endoscopy.

Alternative strategies to reduce the use of upper GI tract endoscopic procedures have previously been investigated.[26] It has become clear from European and Asian studies that an *H pylori* test-and-treat strategy as an alternative to upper GI tract endoscopy results in a significant decrease in the use of upper GI tract endoscopic procedures.[27,28] Despite wide implementation of the test-and-treat strategy, overuse of upper GI tract endoscopy is still present. Those data are mirrored by our study because 67 included patients (56%) had previously been tested and treated for *H pylori*. In addition, the worldwide decline in *H pylori* prevalence reduces the effectiveness of a test-and-treat strategy.[29] A systematic review on the effect of proton pump inhibitors (PPIs) in dyspepsia[30] shows the number needed to treat for a beneficial outcome is 11. Two small European studies explored the effect of empirically prescribed PPI on upper GI tract endoscopy use.[31,32] Both studies achieved more than 60% decrease in the number of upper GI tract endoscopy procedures. However, in our study, 74% of included patients were receiving PPI treatment, suggesting that a strategy using PPIs is imperfect. Moreover, it has been suggested that PPI use may mask underlying disease. An observational study of 100 patients with dyspepsia compared upper GI tract endoscopy results between patients receiving PPI therapy and patients who were not currently receiving PPI (with or without histamine-2 receptor antagonist therapy).[33] In that study, the yield from the endoscopic findings was less in the PPI treated group, suggesting that PPI therapy in patients with ongoing symptoms may mask underlying disease. By contrast, we found that endoscopic findings were independent of PPI use.

Collectively, the outlined strategies are physician-centered and fail to act on the view of patients.[9,27,34,35] Our study fills this hiatus by targeting the patients' gap in knowledge and misconceptions about upper GI tract disease. Further studies will need to assess concurrent and divergent validity of the education tool and to ascertain the efficiency of the uptake of information and whether a longer course or more intense form of psychoeducation would result in further decrease in the number of endoscopic procedures.

Table 1. Baseline Demographic and Clinical Characteristics of the Intention-to-Treat Population

Characteristic	No. (%)	
	Intervention (n = 62)	Control (n = 57)
Demographic characteristic		
Sex		
Male	22 (36)	26 (46)
Female	40 (65)	31 (54)
Age, median (IQR), y	51 (37-57)	47 (35-55)
BMI, median (IQR)	26 (24-28)	25 (21-28)
Center		
CWZ	12 (19)	13 (23)
Viecuri	22 (36)	17 (30)
JBZ	21 (34)	19 (33)
ZGV	7 (11)	8 (14)
Current substance use[a]		
Alcohol	32 (52)	27 (47)
Cigarettes	10 (16)	8 (14)
Narcotics	2 (4)	2 (4)
Level of education (ISCED)		
ISCED 0-4	28 (45)	19 (33)
ISCED 5-6	29 (47)	35 (61)
ISCED 7-8	5 (8)	3 (5)
Employment status		
Currently employed	46 (74)	49 (86)
Disabled	5 (8)	5 (9)
Unemployed	7 (11)	4 (7)
Retired	4 (7)	1 (2)
Health care consumption, prior visits		
General clinician, median (IQR)	2 (1-3)	2 (1-3)
Medical specialist	4 (7)	3 (5)
Emergency department	3 (5)	3 (5)
Psychologist	3 (5)	3 (5)
Dietician	2 (3)	3 (5)
Current medication use[b]		
PPI	39 (63)	43 (75)
H_2RA	3 (5)	1 (2)
Mucosa protectives	2 (3)	1 (2)
Duration of antacid use, mean (SD), wk	65 (124)	99 (230)
Antidepressants	7 (11)	8 (14)
NSAIDs	4 (7)	3 (5)
Prior investigations		
Upper GI tract endoscopy	15 (24)	13 (23)
Colonoscopy	3 (5)	4 (7)
Abdominal ultrasonography	11 (18)	10 (18)
Abdominal computed tomography	0	2 (3)
Electrocardiogram	2 (3)	2 (3)
Helicobacter pylori test[c]		
Positive	0	7
Negative	34	26
Not tested	28	24
PROMs	15 (24)	13 (23)
PAGI-SYM (0-5), median (IQR)	1.30 (0.98-2.05)	1.40 (0.80-1.90)
NDI (0-4.17), median (IQR)	1.24 (0.97-1.5)	1.29 (0.98-1.60)
SHAI (0-3), median (IQR)	0.64 (0.50-0.86)	0.57 (0.36-0.86)

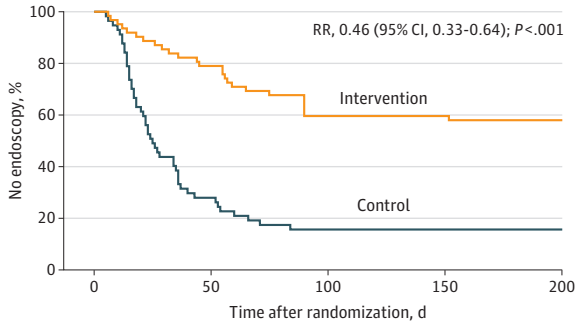
Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); CWZ, Canisius Wilhelmina Hospital; GI, gastrointestinal; H_2RA, histamine-2 receptor antagonist; ISCED, International Standard Classification of Education[24]; IQR, interquartile range; JBZ, Jeroen Bosch Hospital; NSAID, nonsteroidal anti-inflammatory; NDI, Nepean Dyspepsia Index; PAGI-SYM, Patient Assessment of Gastrointestinal Symptoms; PPI, proton pump inhibitor; PROMs, patient-reported outcome measures; SHAI, Short Health Anxiety Inventory; ZGV, Gelderse Vallei Hospital.

[a] Alcohol use is yes if consumed 1 or more units per week; cigarette use, if consumed 1 or more cigarette per week; narcotic use, if regularly used 1 unit or more per week.

[b] Some patients did not use medication, others used more than 1 medication.

[c] Test conducted prior to upper GI tract endoscopy.

Figure 2. Time to Endoscopy Curve



No. at risk					
Intervention	62	49	38	38	37
Control	57	16	10	10	10

Kaplan-Meier curve of the proportion of patients who underwent upper gastrointestinal tract endoscopy in the educational (intervention) and control groups. Relative risk (RR) is the risk of undergoing upper gastrointestinal tract endoscopy within 12 weeks after perusing the web-based educational information compared with receiving no relevant education.

Upper GI tract endoscopy is regularly carried out to reassure patients with uninvestigated dyspepsia. However, the perceived positive effects associated with upper GI tract endoscopy on several aspects of patient well-being are frequently questioned in the literature.[36] We found that educating patients with dyspepsia was equally effective to performing upper GI tract endoscopy in controlling symptom severity and improving the quality of life. Health-related anxiety improved only for patients who received the education. Our findings contrast with a cohort study investigating 420 patients referred for upper GI tract endoscopy.[36] That study failed to show a beneficial effect of upper GI tract endoscopy on the quality of life, especially in the absence of an organic abnormality finding on upper GI tract endoscopy (functional dyspepsia). The difference may be explained by our longer follow-up (3 months vs 1 month) because patients may have been treated longer for any underlying disease and if the endoscopy result was normal, may have found a way to cope with the symptoms. Similar to our study, the results of that study found that upper GI tract endoscopy did not affect health-related anxiety. This accords with data showing that upper GI tract endoscopy reduces health-related anxiety in patients with moderate or high (but not with low) baseline levels of anxiety.[37]

Parallel to the effect of upper GI tract endoscopy on patient-reported outcome measures, the use of upper GI tract endoscopy as a modality to obtain material for histologic evaluation should be considered. In our study, biopsy specimens were obtained in 34% of procedures, the majority of which were taken from visible abnormalities. Emerging evidence shows that approximately 40% of biopsy specimens obtained from visible abnormalities show abnormal histologic examination findings.[38] Diagnoses such as celiac disease, eosinophilic gut disorders, and lymphoid hyperplasia may cause dyspepsia-like symptoms and may be missed without histologic examination of biopsy specimens obtained during upper GI tract endoscopy.[38,39]

A large meta-analysis of 14 trials studied the association between diagnostic procedures with low pretest probability of serious illness and several mental perceptions of disease. The data set included 7 trials of upper GI tract endoscopy in patients with functional dyspepsia and concluded that upper GI tract endoscopy did not contribute to reassurance, illness concern, and symptom resolution.[40] Those data are supported by earlier studies that indicate upper GI tract endoscopy is not associated with improved psychological well-being in patients.[36] The 7 individual studies from the meta-analysis compared upper GI tract endoscopy to another strategy, such as empirical treatment, *H pylori* test and treat, or usual care. Regardless of the strategy, the use of upper GI tract endoscopic procedures was decreased across studies, whereas symptoms and the quality of life did not change in most nonendoscopy groups. Apart from a patient-focused educational strategy, we did not offer a medical treatment that may account for the improvement of symptoms and quality of life in both groups.

Strengths and Limitations

The multicenter design and the unrestricted use of drugs, medical care, or alternative treatment during the study are a clear strength of the present study because they reflect real-world practices and therefore enhance the generalization of our findings. Furthermore, we showed effectiveness of patient education to decrease the use of upper GI tract endoscopy despite a heterogeneous and complex study population. For example, inclusion of patients occurred in a relatively late stage of the clinical care pathway, often preceded by frequent clinician visits and consequent exposure to various medical treatment options or conservative measures. In selecting patients for this study, we were consistently met with resistance from patients as well as the referring clinicians, who favored the original diagnostic track rather than randomization for this trial. This proved to be a barrier for entry of patients in the trial. Parallel education of clinicians may provide a partial solution for this obstacle.

A limitation of our study was the adaptation of the sample size during the trial. We were unable to reach the initially targeted sample size because of recruitment issues. A meta-analysis of randomized clinical trials prematurely terminated because of benefit showed an association with overestimation of the treatment effect.[41] However, our study was not terminated because of benefit, and we took additional measures to minimize risk of bias, including the recalculation of needed sample size by an independent statistician and the use of a more stringent *P* value calculation to determine statistical significance to minimize type I errors. Owing to the nature of our study, blinding was not possible, which may have been a source of bias in our study. Finally, a potential limitation was the timing of our intervention, which may have been suboptimal. We included patients after referral for upper GI tract endoscopy. Higher inclusion rates may be expected if the educational tool is offered earlier in the process, ideally in primary care. On the other hand, offering the educational tool to a larger, unselected group in primary care may result in a reduced success rate because patients may be less motivated than those from our study group. Future research

Table 2. Results of PAGI-SYM, NDI, and SHAI Assessments by Group at Baseline and 12 Weeks After Randomization

Assessment	Intervention (n = 47)			Control (n = 45)		
	Total score, median (IQR)	0 vs 12 wk		Total score, median (IQR)	0 vs 12 wk	
		Mean (95% CI)	*P* value		Mean (95% CI)	*P* value
PAGI-SYM[a]						
0 wk	1.44 (1.19 to 1.68)	0.56 (0.31 to 0.81)[b]	<.001	1.56 (1.24 to 1.88)	0.62 (0.30 to 0.95)[b]	<.001
12 wk	0.96 (0.70 to 1.21)			0.91 (0.61 to 1.21)		
Intervention vs control	0.05 (−0.35 to 0.45)	*t* = 0.25	.80			
NDI[c]						
0 wk	1.24 (0.97 to 1.50)	0.42 (0.16 to 0.68)	<.003	1.29 (0.98 to 1.60)	0.61 (0.30 to 0.91)	<.001
12 wk	0.85 (0.55 to 1.14)			0.69 (0.38 to 1.01)		
Intervention vs control	0.18 (−0.21 to 0.57)	*t* = 0.92	.36			
SHAI[d]						
0 wk	0.84 (0.68 to 0.99)	0.18 (0.05 to 0.31)	.008	0.80 (0.61 to 0.99)	0.08 (−0.00 to 0.16)	.05
12 wk	0.68 (0.53 to 0.83)			0.72 (0.53 to 0.91)		
Intervention vs control	0.09 (−0.24 to 0.06)	*t* = −1.22	.23			

Abbreviations: IQR, interquartile range; NDI, Nepean Dyspepsia Index; PAGI-SYM, Patient Assessment of Gastrointestinal Symptoms; SHAI, Short Health Anxiety Inventory.

[a] Mean total score 0 to 5, with lower scores representing lower severity.

[b] Above minimal clinical important difference of 0.3.

[c] Mean total score 0 to 4.17, with lower scores representing better quality of life.

[d] Mean total score 0 to 3, with lower score representing lower anxiety.

Table 3. Upper Gastrointestinal Tract Endoscopy Results in Control and Intervention Groups, by Receipt of PPI

Endoscopy result	No. of observations			
	Intervention (n = 24)		Control (n = 47)	
	PPI yes[a]	PPI no[a]	PPI yes[a]	PPI no[a]
No abnormality, No. (%)	11 (46)	5 (21)	22 (47)	5 (11)
Not clinically relevant, No. (%)	2 (8)	2 (8)	12 (26)	2 (4)
Gastritis or duodenitis[b]	0	0	3	0
Diaphragmatic hernia	2	1	3	0
Reflux esophagitis grade A[c]	0	0	3	1
LOS incompetence	0	1	1	0
Other[d]	0	0	2	1
Clinically relevant, No. (%)	2 (8)	2 (8)	4 (9)	2 (4)
Helicobacter pylori–associated gastritis	0	1	2	0
Reflux esophagitis grade B, C, or D[c]	2	1	1	1
Barrett esophagus[e]	0	0	1	0
Gastric ulcer[f]	0	0	0	1

Abbreviations: LOS, lower esophageal sphincter; PPI, proton pump inhibitor.

[a] PPI yes indicates currently using PPIs; and PPI no, currently not using PPIs.

[b] Histologically proven.

[c] Esophagitis grading according to Los Angeles classification.

[d] Planned procedures not performed after 24 weeks, 1 leiomyoma.

[e] Histologically confirmed short-segment Barrett esophagus (<3 cm).

[f] Complete resolution observed at follow-up upper gastrointestinal tract endoscopy.

is needed to determine this effect of early intervention in a different setting. A description of such a future study is provided in the eAppendix in Supplement 2.

Conclusions

The use of upper GI tract endoscopy for patients with dyspepsia can be effectively decreased by a rate of more than 40% by implementing relevant web-based patient education. We advocate the implementation of an online accessible patient education platform for dyspepsia management, in both primary and secondary care, to further decrease overuse of health care. Future studies should focus on the long-term outcomes of reducing upper GI tract endoscopy use through patient education. In addition, the effect of educating patients in earlier disease stages (ie, at first presentation) on the use of upper GI tract endoscopy is yet to be established.

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