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Esophageal Symptoms and Lumbosacral Back Pain

Ravinder K. Mittal,
Charlie Le,
Melissa Ledgerwood,
Da Kyung Jung,
Vignesh Gandu,
Ali Zifan

Division of Gastroenterology, Department of Medicine University of California San Diego, San Diego, California

Abstract

BACKGROUND AND AIMS: Esophageal symptoms, that is, heartburn, regurgitation, dysphagia, and chest pain are common in the general population. Also common are symptoms of back pain related to pathology in the lumbosacral spine. The right crus of the diaphragm that forms the esophageal hiatus, originates from lumbar spine, may be affected by lumbar spine pathology resulting in esophageal symptoms. We studied whether there was an association between esophageal symptoms and spine symptoms.

METHODS: Two patient groups of 150 each were investigated: group 1 (ES); patients referred to the esophageal manometry study for assessment of esophageal symptoms, group 2 (SC); patients undergoing screening colonoscopy (control group). Both groups completed standardized questionnaires assessing esophageal and spine symptoms.

RESULTS: Back pain was reported by 74% of patients in the ES group as compared to 55% of patients in the SC group. Thirty percent of patients in the SC group reported one or more esophageal symptoms and these patients were regrouped with the ES group, resulting in 2 groups,

Correspondence: Address correspondence to: Ravinder K. Mittal, MD, ACTRI, 9500 Gillman Drive, MC 0061, La Jolla, California 92093-0990. rmittal@ucsd.edu.

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Ravinder K. Mittal: Conceived and designed experiments, data interpretation, and manuscript writing. Charlie Le: Data collection and organization. Melissa Ledgerwood, Da Kyung Jung, and Vignesh Gandu: Data collection. Ali Zifan: Data analysis, figure generation, and manuscript writing.

Conflicts of Interest:
The authors disclose no conflicts. Ravinder K. Mittal is a member of the Board of Editors. Their paper was handled in accordance with our conflict of interest policy. See https://www.ghadvances.org/content/authorinfo#conflict_of_interest_policy for full details.

Ethical Statement:
This research was approved by the UC San Diego Institutional Review Board (IRB), #: 190429.

Data Transparency Statement:
The data that support the findings of this study are available from the corresponding author upon reasonable request.

Reporting Guidelines:
Helsinki Declaration.

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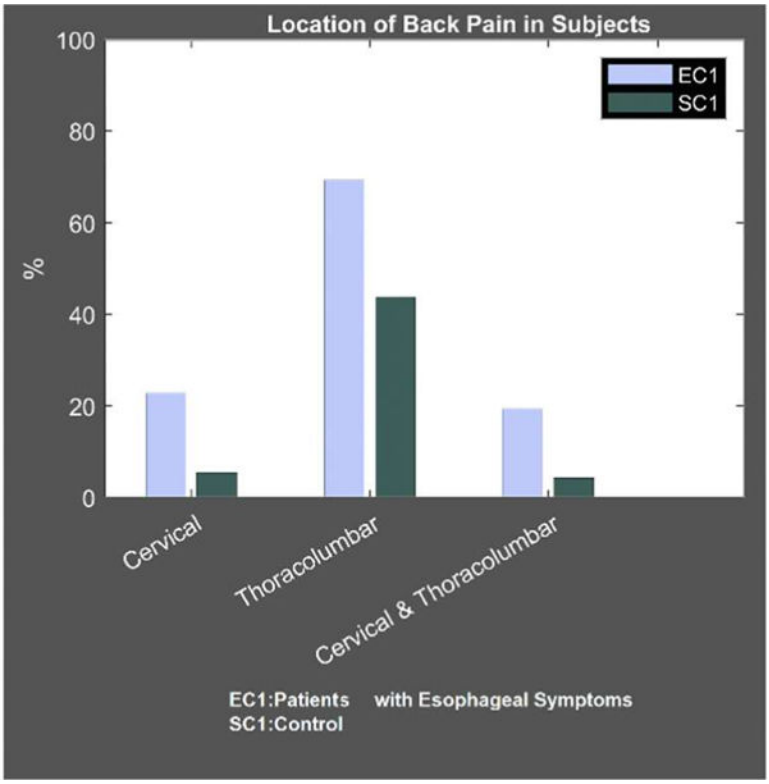
ES1 and SC1, with and without esophageal symptoms, respectively. The ES1 group was 3.3 times more likely to experience back pain compared to the SC1 group (95% confidence interval: 1.95–5.46). Thoracolumbar was the most common site of pain in both groups. Pain score was greater for the group with esophageal symptoms compared to controls. Narcotic intake for most patients in the ES1 group was for back pain.

CONCLUSION: A strong association between esophageal symptoms and thoracolumbar back pain raises the possibility that structural and functional changes in the esophageal hiatus muscles related to thoracolumbar spine pathology lead to esophageal dysmotility and symptoms.

Graphical Abstract



Keywords

Thoracolumbar Back Pain; Esophageal Symptoms; Esophageal Hiatus

Introduction

Symptoms related to gastroesophageal reflux disease and esophageal motility disorders (EMDs) are extremely common in the general population in the United States and worldwide. Studies conducted using standardized questionnaire reveal that 25%–35% of the US population suffer from heartburn, regurgitation, and/or esophageal chest pain on a weekly basis.[1–3] Gastroesophageal reflux disease is caused by an incompetent antireflux barrier at the esophagogastric junction/lower esophageal sphincter (LES) that results in reflux of gastric contents into the esophagus, which is responsible for the genesis of

heartburn, chest pain, and regurgitation. Transient LES relaxation, low LES pressure, and sliding hiatus hernia are major factors that define an incompetent antireflux barrier. However, the precise cause of physioanatomic abnormality that results in an incompetent antireflux barrier is not known.

Dysphagia, a cardinal symptom of EMDs is experienced by 15%−20% of the US population.[4] Following a negative barium swallow study, normal upper endoscopy exam, and biopsy (to exclude eosinophilic esophagitis), patients are often referred for an esophageal manometry study. Achalasia esophagus, diffuse esophageal spasm, esophagogastric junction outflow obstruction, high amplitude esophageal contraction/jackhammer esophagus, and ineffective EMDs are examples of primary EMDs,[5] and dysphagia is the predominant symptom of all primary EMDs. Impaired LES relaxation and abnormalities of esophageal peristalsis are used to categorize primary EMDs. Even though high-resolution manometry and Chicago Classification have been effective in diagnosing and classifying primary EMDs, the primary cause of EMD remains unknown.

Abnormalities of the esophageal hiatus can lead to hiatus hernia, which is a significant player in the pathogenesis of reflux disease and myriad of reflux symptoms.[6] Laxity of phrenoesophageal ligament related to lower and abnormal collagen contents,[7] and mutation in collagen type 3 gene[8] is thought to cause sliding hiatus hernia. On the other hand, hiatus hernia is uncommon in patients with achalasia esophagus.[9] Unlike in normal subjects, the LES does not slide out of hiatus during swallow-induced peristalsis in patients with achalasia esophagus, a result of tight anchoring between the hiatus and LES.[10] Esophageal hiatus is formed by the right crus of diaphragm that originates from the lumbar spine, L1, L2, and L3. Animal and human studies show that the pathological changes in the spine can lead to fibrous and fatty changes in the muscles that originate from the spine.[11–13]

Back pain is the cardinal symptom of lumbar spine pathology, and similar to esophageal symptoms, it is also quite common in the general population. PubMed search, looking for an association between the thoracolumbar spine pathology and esophageal motility revealed only case reports of dysphagia, hiatus hernia, and reflux symptoms in patients with extreme kyphoscoliosis.[14–16] We hypothesized that patients with symptoms related to thoracolumbar spine pathology are more likely to have symptoms related to esophagus. The goal of our study, therefore, was to determine the prevalence of back pain in patients with and without esophageal symptoms.

Methods

We conducted an epidemiological study using standardized questionnaires completed by 2 groups of patients: 1) patients referred to the esophageal function testing laboratory at the University of California, San Diego for the high-resolution esophageal manometry (HREM) study in relation to their esophageal symptoms; and 2) patients undergoing screening colonoscopy at the University of California, San Diego. The study was approved by the institutional review board and all subjects signed an informed consent prior to their participation in the study. The purpose-built standardized multi-questionnaire consisted of questions related to the demographics, esophageal, and spine symptoms. The esophageal

symptoms were assessed using standardized reflux questionnaire,[17] chest pain questionnaire, brief esophageal dysphagia symptom,[18] and a purpose-built spine symptoms questionnaire. The later assessed following in relationship to back pain: presence/absence, location, severity, doctor visit, medications intake including narcotics, imaging studies, and spine surgery (Supplement 1). Patients completed the questionnaire in approximately fifteen to twenty minutes, prior to undergoing HREM or screening colonoscopy. The data from the questionnaires filled out on the papers were manually exported to an Excel sheet for statistical analysis.

Statistical Analysis

The questionnaire data were analyzed with Matlab 2021a (MathWorks, Ltd) and SPSS v.28 software package (IBM SPSS Statistics, IBM Corp.). Continuous variables are expressed as means ± standard deviation. Categorical variables are expressed as number (percentage). For intergroup comparisons, continuous variables were analyzed by the Student's *t*-test or univariate analysis of variance, and categorical variables were analyzed by the c2 test or Fisher exact test. To identify factors independently associated with the development of back pain, we performed unconditional logistic regression to identify predictors of cervical and thoracolumbar back pain (dependent variable) among clinically relevant factors (age, sex, body mass index (BMI), dysphagia status(0 = no, 1 = yes), heartburn status(0 = no, 1 = yes), chest pain status (0 = no, 1 = yes), reflux status (0 = no, 1 = yes), doctor visit (0 = no, 1 = yes), spine imaging (0 = no, 1 = yes), surgery (0 = no, 1 = yes), and narcotic use (0 = no, 1 = yes). For each regression on any chosen dependent variable, the predictors that were found to be related to the dependent variable (*P* value ≤ .20) were then entered into the multivariable logistic regression model, and Hosmer–Leme show tests were conducted as an indication of the goodness of fit for the logistic models; a nonsignificant test indicates that the model is well fitted. Finally, the estimated effects from the model were expressed as odds ratios with 95% confidence intervals (CIs). All statistical tests were 2-sided, and a *P* value of less than .05 was considered statistically significant.

Results

Three hundred patients from the 2 clinics (150 each), esophageal clinic (EC) (patients referred for HREM) and screening colonoscopy (SC) group were enrolled in the study. Three patients in the EC group did not fill out the questionnaires correctly and were excluded. There was no statistical difference with regard to the age 57 ± 14 vs 58 ±13, (*P* = .25) and BMI 27. ± 5 6 vs 26.7 ± 5 year, (*P* = .15) between the 2 groups. There were more females in the esophageal as compared to the colonoscopy group, 89 vs 71 (*P* = .036) (Table).

Back pain was reported by 74% of patients in the EC group (Figure 1A) as compared to 55% of patients in the SC group (Figure 1B). Fifty-nine patients in the SC group reported one or more esophageal symptoms and these patients were merged with patients in the EC group, thus forming 2 new groups, EC1 and SC1, with and without esophageal symptoms, respectively. This merger did not cause any changes in differences between age (*P* = .62) or BMI (*P* = .07) in the new groups. Seventy-three percent of patients in the EC1 were

found to have back pain (Figure 1C) as compared to 45% in the SC1 group (Figure 1D), the difference between the 2 groups was statistically significant ($P < .001$). Subjects in the EC1 group were 3.27 times more likely to have experienced back pain, as compared to the SC1 group (95% CI: 1.95–5.46).

Figure 2 shows the prevalence of specific esophageal symptoms such as dysphagia, heartburn, regurgitation, and chest pain in the 3 groups, EC, SC, and EC1. Patients in the SC group have a lower prevalence of symptoms than patients in the EC group. With regard to the distribution of dysphagia, chest pain, regurgitation, and heartburn symptoms in the EC1 group with back pain as compared to no back pain, only chest pain was more prevalent in the EC1 with back pain subjects (odds ratio = 2.78; 95% CI: 1.43–5.4) (Figure 2C).

The thoracolumbar was the most common site of back pain (69.42% in EC1 and 43.96% in SC1 group), followed by thoracolumbar and cervical (19.42% in EC1 and 4.4% in SC1), and cervical only (22.82% in EC1 and 5.5% in SC1) (Figure 3). Patients with higher back pain scores were greater in the EC1 group as compared to the SC1 group ($P < .001$). On the other hand, patients with lower back pain scores were greater in the SC1 group as compared to the EC1 group ($P < .001$) (Figure 4). Severity of back pain was also assessed by determining the following in relation to back pain; doctor visit, imaging studies (X ray, CT scan, and MRI), medications intake and surgery in the EC1 and SC1 groups. Figure 5 shows that in the EC1 group, 54% of patients with back pain had visited a doctor, more than the SC1 group (43.9%) ($P < .001$), 68.7% had imaging studies, higher than in the SC1 group (16.5%) ($P < .001$). Medication for back pain was reported by 49.3% and 43.9% in the EC1 and SC1 groups, respectively ($P = .004$). 10.7% of patients in the EC1 group had surgery as compared to 4.9% in the SC1 group, with a trend toward statistical significance ($P = .062$).

Figure 6 shows patients taking narcotics in the EC1 and SC1 groups. 12.6% (Figure 6A) of patients with esophageal symptoms (EC1) were taking narcotics as compared to 1.1% of patients in the SC1 group (6C) ($P < .001$). Most patients with esophageal symptoms taking narcotics (92% vs 8%) had spine symptoms (6B). On the other hand, none of the patients in the SC1 group with no esophageal and spine symptoms were taking narcotics (6D). Above implies that patients with esophageal and spine symptoms were more likely to be taking narcotics as compared to the ones with spine symptoms only.

Figure 7 shows manometry diagnosis in the EC group. The number of patients in the individual manometric diagnosis group was relatively small to do meaningful comparison of whether any specific manometric group was more likely to be associated with spine symptoms.

Discussion

In summary, our data show the following: 1) The 2 groups that we studied are similar with regard to the age and BMI but there are more women in the EC as compared to the SC group. 2) Spine symptoms are 3.3 times more prevalent in patient with the esophageal symptoms as compared to no esophageal symptoms. 3) Severity of back pain, doctor visits, imaging studies, medication intake, and surgery for back pain are greater in patients with

esophageal symptoms as compared to without esophageal symptoms. 4) Thoracolumbar region is the most common site of back pain. 5) Narcotic intake is more in patients with esophageal symptoms and majority of these patients are taking narcotics for spine symptoms. 6) The prevalence of specific EMD in patients who underwent manometry studies at our institution is approximately the same as reported in the literature by other tertiary care centers.[19,20]

Similar to dysphagia, reflux symptoms, and esophageal pain, back pain is also fairly common in the general population, 70%–85% of all people have back pain at some time in life, with an annual prevalence that ranges from 15% to 45% with the point prevalence averaging 30%.[21,22] In the United States, back pain is the most common cause of activity limitation in people younger than 45 years, the second most frequent reason for visits to physician, fifth-ranking cause of admission to the hospital, and the third most common cause of surgical procedures. The UK estimates that low back pain is responsible for 12.5% of all sick days in the country. Cross-sectional surveys of local populations corroborate the data from the national surveys, representative data that range from 12% to 35%. Back pain is the cardinal symptom of degenerative changes in the lumbar spine and intervertebral discs. Vertebral endplate signal changes (Modic changes) seen on the MRI have been shown to be more consistently associated with low back pain symptoms than the intervertebral disc pathology. The prevalence of intervertebral disc pathology occurring concurrently with Modic changes ranged from 17% to 26% (type 1 and/or 2 Modic changes).[23]

In rabbit model of disc injury, Brown et al observed an increase in the space between muscle bundles, increase in the fat content and rigidity of multifidus muscle (a paraspinal muscle) following experimentally induced disc injury.[11,13] Biopsy of the multifidus muscle (attached to lumbar spine) in patients undergoing spine surgery for back pain revealed high levels of muscle degeneration, increase in connective tissue and inflammatory cells, and decrease in the vascularity of muscle.[12] Biopsy of the crus muscle in patients with hiatus hernia show degeneration of muscle fibers in 90% of patients and in 75% of these patients the lesion was considered to be severe.[24,25] We found that 5 out of 10 patients with achalasia esophagus had what appear to be physical break in the crus muscle, and these patients also show significant pathology in the lumbar and lower thoracic spine (large osteophytes and disc collapse).[26] We propose that lumbar spine pathology may lead to degeneration and fibrosis in the right and left crus muscles of the diaphragm, which form the esophageal hiatus, which then secondarily lead to LES dysfunction and esophageal dysmotility. A laxity of the hiatus may result in formation of sliding hiatus hernia. On the other hand, inflammation in the hiatal muscles may lead to fibrosis and scarring that may result in tight anchoring between the LES and hiatus muscle[10] in achalasia patients. Obstruction at the level of LES may lead to obstructive changes in the esophageal muscle and EMDs, as revealed by animal studies.[27–30]

Narcotic medication intake is considered to be a risk factor for the EMDs.[31,32] We found a high prevalence of narcotic intake in patients with esophageal symptoms (13%) as compared to the control group (colonoscopy group without esophageal symptoms (1%). Majority of the patients in the esophageal symptom group were taking narcotics for back pain (92% vs 8%). None of the patients in the control group were taking narcotics if they did not have

esophageal and spine symptoms (0%). Based on the above observations, one may conclude that the narcotic intake was not for primary esophageal symptoms; instead, it was mostly for back pain reason, which raises the possibility that spine issue rather than narcotics intake is the cause of esophageal motor dysfunction. Whether narcotic intake exaggerates esophageal symptoms can't be excluded from our study. We do not have precise data on the dose of narcotics being consumed by the patient so can't answer the question related to the narcotic dose and esophageal symptoms.

There are several limitations of the study. 1) We studied patients referred for esophageal manometry studies which are likely to be those patients with greater esophageal symptom as compared to the ones seen in primary care practice. 2) Do patients undergoing screening colonoscopy represent adequate control group? There was no difference in the age and BMI between the 2 groups, which may be considered as risk factors for the esophageal as well as spine symptoms. Forty-five percent of patients in the colonoscopy group reported back pain but no esophageal symptoms, so back pain alone can't explain the presence or absence of esophageal symptoms. 3) There were more women in the esophageal group, which may be related to a greater number of males as compared to females undergoing screening colonoscopy. However, we find that a greater number of females than males are referred for esophageal manometry studies at our institution. We found approximately 1/3rd of the colonoscopy group had esophageal symptoms. We analyzed our data by either excluding patients with esophageal symptoms from the SC group or adding them into the symptomatic esophageal group (ES1). It did not change back pain as a risk factor for esophageal symptoms, and we present the data both ways (Figure 1). 4) Our cross-sectional study can't answer the question which came first, esophageal symptoms or spine symptoms. 5) Finally, one must bear in mind, that our study shows an association between back pain and esophageal symptoms, it does not provide proof of the cause-and-effect relationship. Association studies can only provide evidence of some relationship (between exposure and outcome). To determine the cause-and-effect relationship will require further studies and possibly animal experimentation.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Funding:

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Abbreviations used in this paper:

BMI	body mass index
CIs	confidence intervals
EMDs	esophageal motility disorders
HREM	high-resolution esophageal manometry

LES	lower esophageal sphincter

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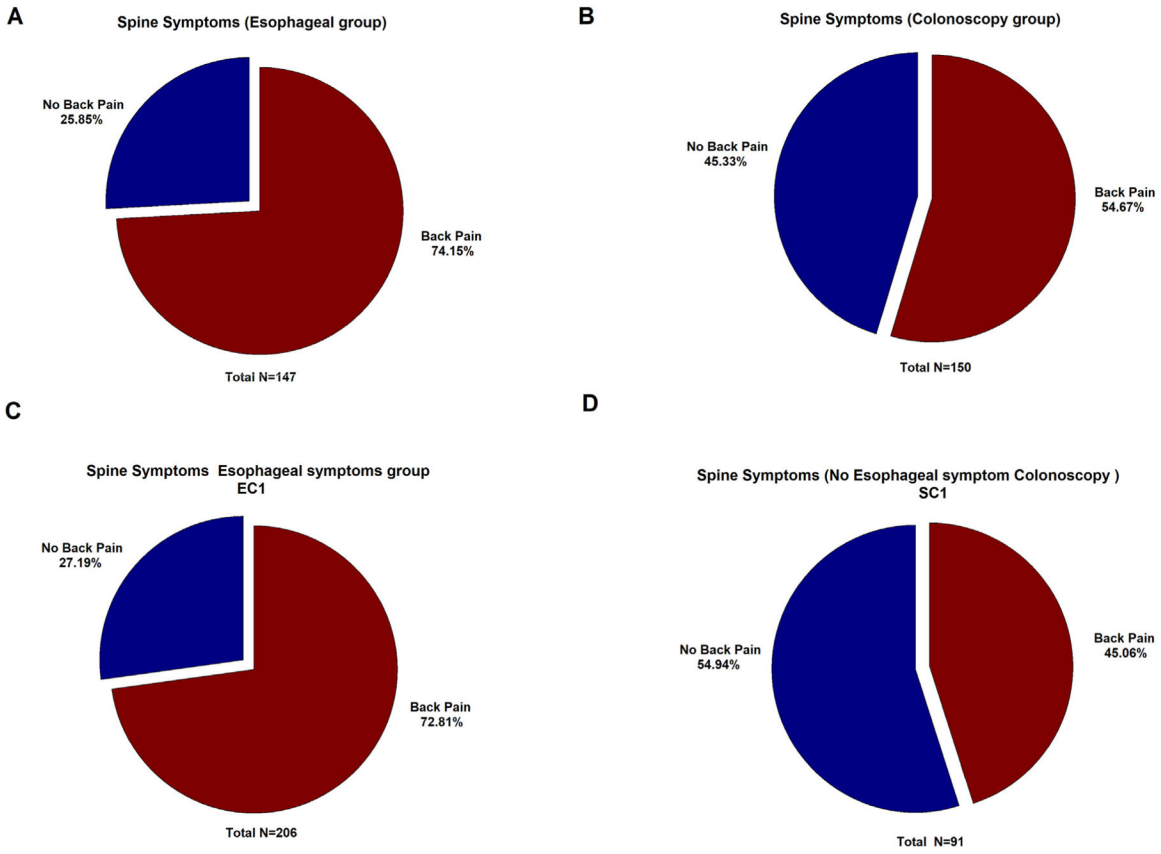

Figure 1.

Frequency of spine symptoms in patients with esophageal symptoms and controls. (A) Percent patients referred for esophageal motility who have spine symptoms (EC). (B) Percent patients in the colonoscopy who have spine symptoms (group SC). (C) Percent patients from the ones in group A and in group B combined who have esophageal symptoms, (group EC1). (D) Percent patients from group B (colonoscopy group) who do not have esophageal symptoms (group SC1).

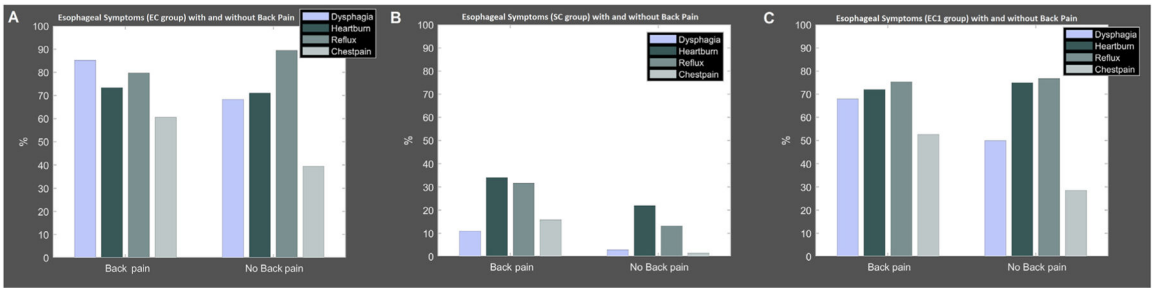

Figure 2.

Esophageal symptoms in patients with and without back pain. (A) Esophageal symptoms in patients referred for esophageal motility study, with and without back pain. (B) Esophageal symptoms in patients undergoing colonoscopy, with and without back pain. (C) Esophageal symptoms after regrouping patients from the ones for esophageal motility study and patients in the colonoscopy group who have esophageal symptoms (group EC1), with and without back pain.

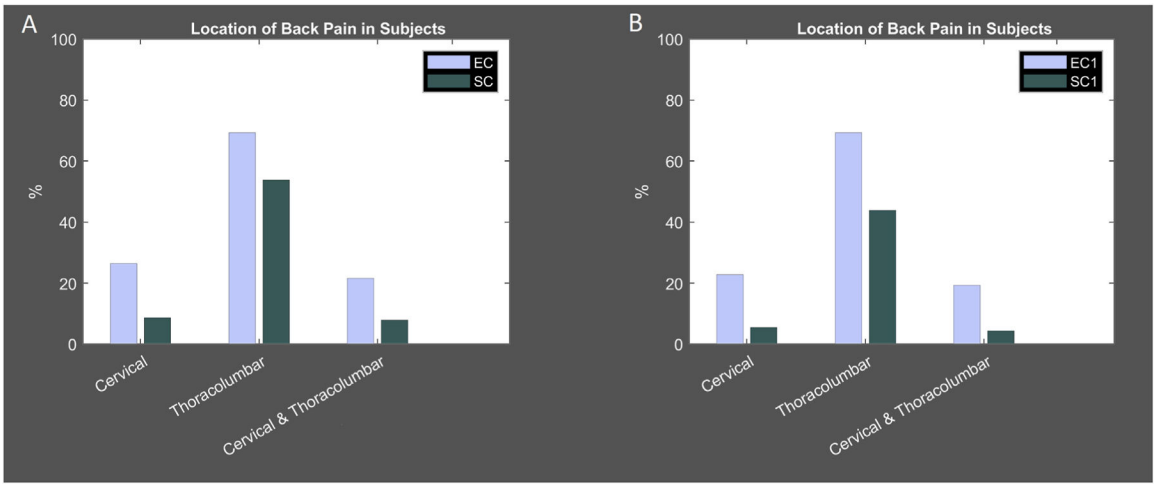

Figure 3.
Location of back pain in patients with (A) and without esophageal symptoms (B).

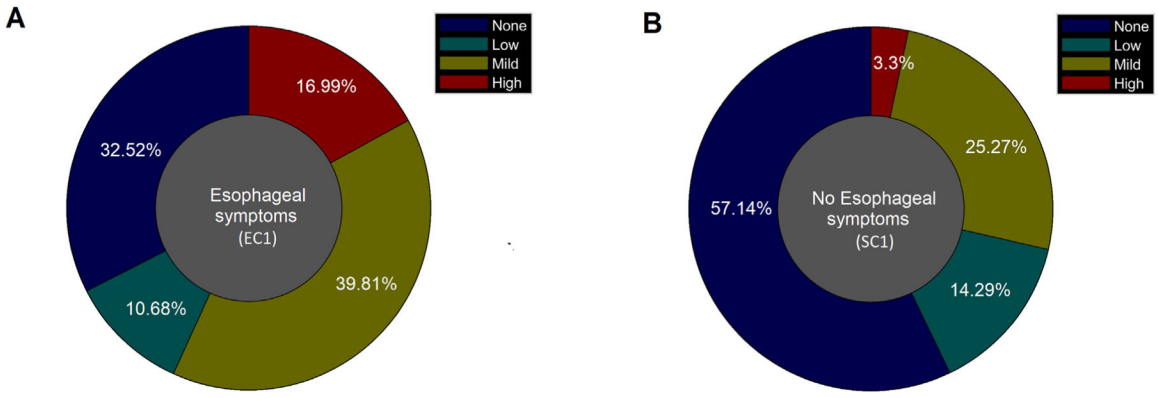

Figure 4.

Severity of back pain in patients with (A) and without esophageal symptoms (B). Patients with esophageal symptoms have higher back pain scores (group EC1) than patients with no esophageal symptoms (group SC1).

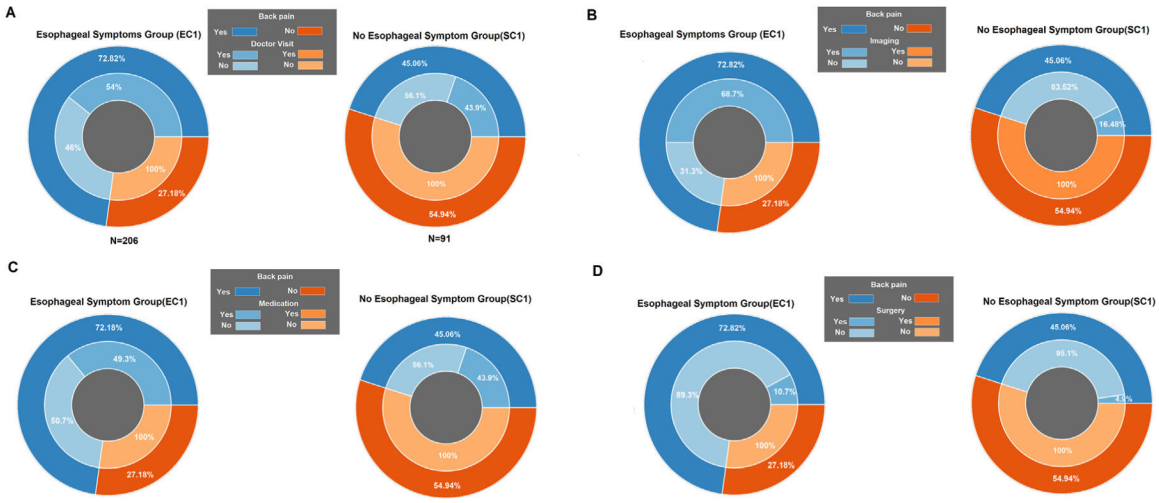

Figure 5.

Doctor visits, imaging studies, medication intake and surgery for spine in patients with esophageal symptoms. (A) Percent patients with esophageal symptoms with visits to the doctor for back pain. (B) Percent patients with esophageal symptoms with have imaging studies of spine. (C) Percent patients with esophageal symptoms taking medications for back pain. (D) Percent patients with esophageal symptoms having had spine surgery.

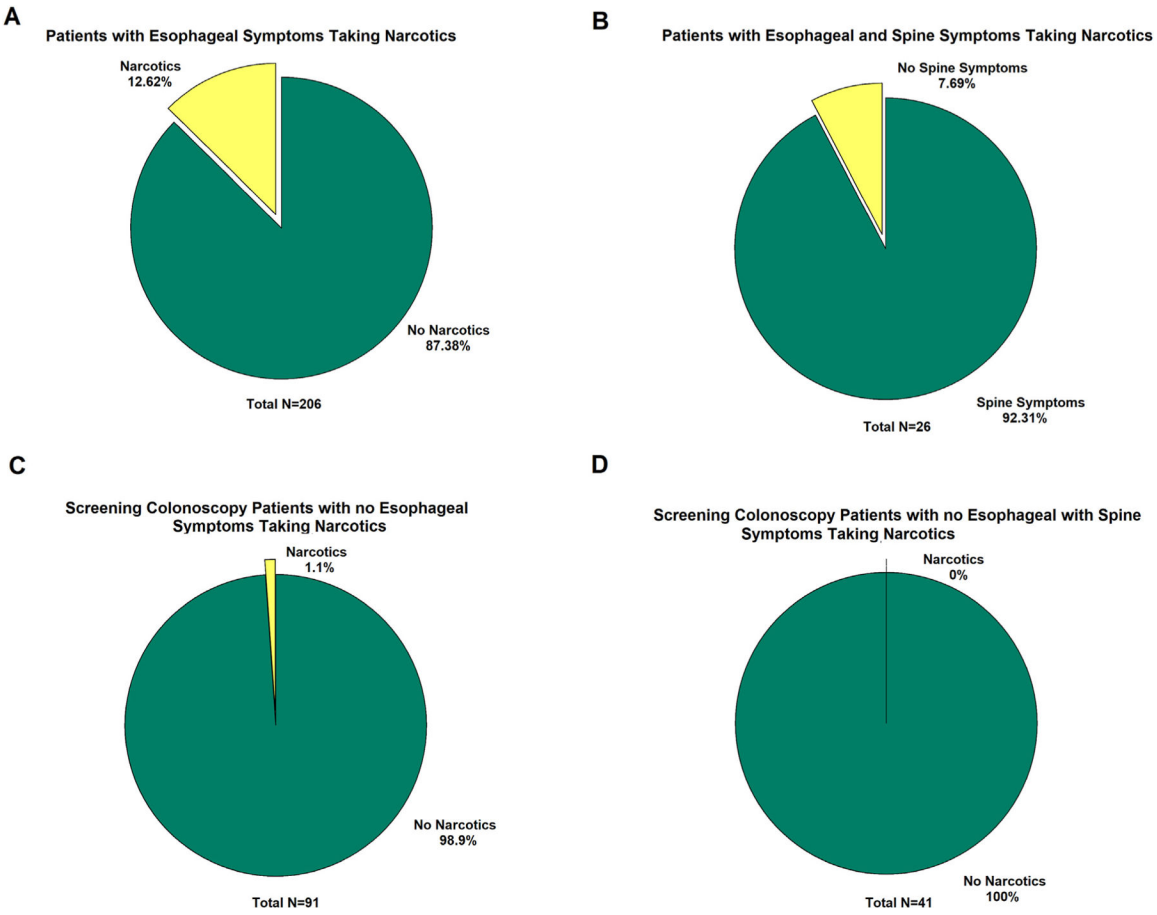

Figure 6.

Narcotics intake in patients with and without esophageal symptoms. (A) Narcotic intake in EC1 patient group with esophageal symptoms. (B) Narcotic intake in EC1 patient group with and without spine symptoms. (C) Narcotic intake in patient in the colonoscopy group with no esophageal symptoms (group SC1). (D) Narcotic intake in patients in SC1 group with no esophageal and no spine symptoms.

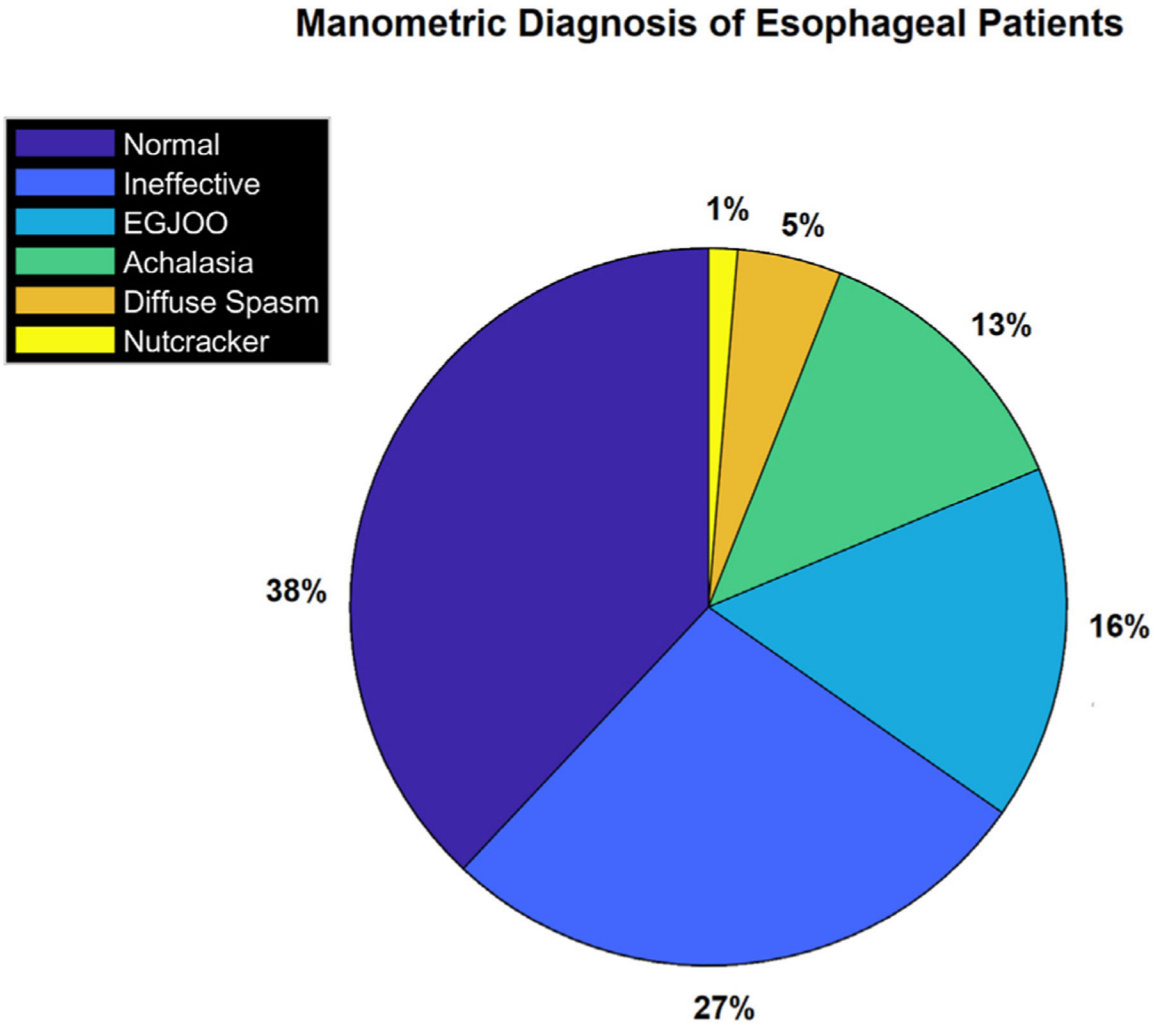

Figure 7.
Manometric diagnosis (based on Chicago 3.0) of patients referred for esophageal motility testing (group EC).

Table.

Subject Demographics

Characteristics	Esophageal patients (n = 147)	Controls (n = 150)
Median age	57	58
Mean age	57 ± 14	58 ± 13
Mean BMI	27.5 ± 6	26.7 ± 5
Male	61	79
Female	89	71