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FEATURES OF ESOPHAGEAL MOTILITY AND THE ESOPHAGOGASTRIC JUNCTION IN ACHALASIA AND HIATAL HERNIA: A COMPARATIVE STUDY

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Background. Esophagogastric junction motility disorders in achalasia and hiatal hernia are accompanied by alterations in the barrier function of the lower esophageal sphincter and impaired coordination of esophageal peristaltic activity. Quantitative intraluminal pressure recording enables objective assessment of the pathophysiological mechanisms underlying these disorders and allows evaluation of intersegmental features of motor regulation.

Materials and Methods. A total of 165 patients were examined and divided into three groups: control (n = 15), achalasia (n = 50), and hiatal hernia (n = 100). Intraluminal pressure was recorded using a pneumatic balloon fixed to an endoscopic probe. Pressure in the region of the lower esophageal sphincter and the pyloroduodenal junction was measured, as well as the amplitude and period of peristaltic and rhythmic pressure oscillations. Results are presented as Me (Q25; Q75). Intergroup comparisons were performed using the Kruskal–Wallis test followed by Dunn's post hoc test with Bonferroni adjustment for multiple comparisons.

Results and Discussion. Pressure during the passage through the lower esophageal sphincter in the hiatal hernia group was 4.52 (1.30; 12.64) mmHg and was significantly lower than in the control group, 19.54 (18.25; 20.12) mmHg, and the achalasia group, 22.80 (9.76; 43.69) mmHg ($H = 51.44$; $p < 0.001$). The peristaltic wave period was shorter in patients with hiatal hernia than in the control group ($p = 0.010$). The amplitude of peristaltic and rhythmic contractions did not demonstrate statistically significant intergroup differences. Changes in motor parameters were multidirectional and depended on the nosological form.

Conclusion. In this study, LES-region pressure measured during the balloon passage showed the largest intergroup contrast, caused by markedly lower values in the hiatal hernia group, and thus demonstrated the clearest between-group contrast within the applied protocol. This finding is consistent with reduced antireflux barrier competence in hiatal hernia. However, the balloon “pressure during passage” metric reflects integrated mechanical resistance and is not directly equivalent to HRM-derived basal LES pressure or integrated relaxation pressure (IRP). In achalasia, this metric did not differentiate patients from controls in our cohort and should not be interpreted as a stand-alone marker of impaired LES relaxation. Peristaltic and rhythmic activity of the esophageal body shows high variability and limited diagnostic specificity.

Keywords: esophageal motility disorders, lower esophageal sphincter, antireflux barrier, achalasia, hiatal hernia, esophageal rhythmic activity

INTRODUCTION

Disorders of esophageal and gastroesophageal junction (GEJ) motility in achalasia and hiatal hernia (HH) are regarded as clinically significant phenotypes of dysphagia and reflux-associated pathology, in which both the barrier properties of the lower esophageal sphincter (LES) and the propulsive function of the esophagus are altered. Contemporary diagnostic assessment is centered on high-resolution manometry (HRM) and esophagogastric junction (EGJ) barrier metrics, which enable characterization of motility patterns and identification of EGJ outflow impairment (Fox *et al*., 2021; Kahrilas *et al*., 2021). In achalasia, the key pathophysiological mechanism is considered to be the loss of inhibitory neuronal regulation with impaired LES relaxation and secondary alterations in peristalsis, contributing to the clinical and manometric heterogeneity of the disease (Rengarajan *et al*., 2025; Ali *et al*., 2025). In HH, mechanical distortion of GEJ anatomy and alterations in sphincter zone configuration may coexist with ineffective esophageal body motility and reduced peristaltic efficiency, which should be considered when interpreting intraluminal pressure measurements and planning treatment strategies (Sillcox *et al.*, 2023).

Although HRM is widely regarded as the reference method for esophageal motility assessment, its routine implementation has well-recognized practical and methodological constraints. HRM performance and interpretation remain dependent on standardized protocols, operator expertise, catheter positioning, and patient cooperation, while technical artifacts and procedure-related factors may influence pressure metrics and pattern recognition (Ruiz de León San Juan *et al.,* 2017). Moreover, despite major progress over recent decades, critical discussions emphasize that challenges related to the clinical translation, reproducibility, and context-dependent interpretation persist even in expert practice (Sweis & Fox, 2020). These considerations motivate interest in complementary, endoscopy-integrated quantitative approaches for selected clinical settings, particularly when HRM is unavailable or technically difficult.

Alongside HRM, endoscopically integrated functional assessment methods are actively evolving. FLIP panometry shows high concordance with HRM (Chicago Classification v4.0) and provides complementary assessment of GEJ opening and contractile responses to distension (Fass *et al*., 2025). In clinical situations where standard manometry is technically challenging, endoscopically assisted HRM under sedation is a valid approach for obtaining reproducible motor data (Cohen *et al*., 2024; Pesce *et al*., 2023; Hani de Ardila *et al*., 2024).

In this context, balloon- and probe-based techniques may offer an endoscopically assisted, protocolized estimate of intraluminal pressure changes associated with passage through physiologic narrowings and sphincter zones, supporting comparative functional assessment across nosologies when reference testing is not readily accessible (Halinska *et al*., 2025). Importantly, this approach is intended as complementary rather than equivalent to HRM/FLIP, and its limitations should be considered when interpreting findings.

Accordingly, the present work applies a single pneumatic balloon protocol to compare (a) LES-region pressure and (b) pyloroduodenal junction pressure, together with esophageal peristaltic and rhythmic pressure oscillation parameters, in patients with achalasia and HH. In Ukraine, access to HRM remains limited and uneven across clinical settings (Stepanov *et al*., 2025), which underscores the practical value of standardized, endoscopy-integrated intraluminal pressure assessment when reference testing is unavailable or technically difficult. This work focuses on distinguishing sphincter-barrier dysfunction from highly variable esophageal body (peristaltic and rhythmic) parameters.

The aim of the study was to compare the functional state of the esophagogastric and pyloroduodenal junctions using pneumatic balloon intraluminal pressure measurements in patients with achalasia and hiatal hernia.

MATERIALS AND METHODS

Study design. A single-center observational study was conducted at the Department of Digestive Surgery of the State Institution “Institute of Gastroenterology of the National Academy of Medical Sciences of Ukraine” in 2023–2024. The analysis included 165 examined individuals, who were allocated into three groups: Group I (control), n = 15; Group II (achalasia), n = 50; and Group III (hiatal hernia), n = 100. The median age in the control group was 38 years (22.75; 48.5), in the achalasia group 48 years (34; 55), and in the hiatal hernia group 53 years (41; 60). Men predominated in all three groups. Potential differences between groups in age and sex were considered during the interpretation of the obtained motor parameters.

The control group was formed from individuals who underwent the same basic diagnostic algorithm as patients in the main groups; during the initial examination, potential “controls” were excluded if structural pathology or signs of upper gastrointestinal functional impairment were identified. This screening step, followed by exclusion of individuals with a detected pathology, accounted for the relatively small size of the control group. No *a priori* sample size or power calculation was performed, as the study was exploratory in nature and was based on consecutive patient enrollment and technical adequacy of the recordings.

Diagnostic evaluation. To assess the functional status and verify the diagnosis, patients underwent radiographic examination of the esophagus, stomach, and duodenum. Classification of achalasia subtypes according to the Chicago Classification and detailed characterization of hiatal hernia types (sliding or paraesophageal) were not performed within this study, as these aspects were not among the primary objectives. The aim of the study was a comparative evaluation of general patterns of esophageal and esophagogastric junction motility in two fundamentally different nosological entities – achalasia and hiatal hernia – from the perspective of functional organization of the sphincter apparatus and peristaltic activity, rather than a delailed analysis of intranosological variability.

The chosen approach allowed focusing on the basic pathophysiological differences between neurogenic impairment of sphincter relaxation (achalasia) and structural-anatomical disintegration of the esophagogastric junction (hiatal hernia), in line with the stated objective of a comparative study. At the same time, the authors acknowledge that clinical and functional heterogeneity of achalasia subtypes and hernia types may influence individual motor parameters; this should be regarded as a limitation of the study and a prospect for future research.

Ethics statement. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki of the World Medical Association (World Medical Association, 2013). The study protocol was reviewed and approved by the local Bioethics Committee of the State Institution „Institute of Gastroenterology of the National Academy of Medical Sciences of Ukraine" (Protocol No 2, April 7, 2022). Written informed consent was obtained from all participants. The study was observational and limited to standard diagnostic procedures.

Intraluminal pressure recording methodology. To assess the motor-kinetic function of the esophagogastric and gastroduodenal regions, pneumatic balloon intraluminal pressure recording was performed under endoscopic guidance. A commercially available lithoextraction balloon (Microtech Stone Extraction Balloon) was connected via a three-way stopcock to a digital pressure sensor and an inflation syringe. Before each examination, the system was checked for airtightness and balloon integrity and calibrated against a reference manometer. Measurements were recorded within a 0–500 mmHg range, with 1 arbitrary unit approximated to 1 mmHg.

To minimize mechanical distension and ensure reproducible contact conditions, the balloon was inflated with a standardized air volume (4 mL) that was kept constant throughout the examination. The balloon was advanced endoscopically in a distal-to-proximal direction (duodenum, stomach, lower esophagus). A 30-second baseline pressure profile was recorded in each segment, and peak pressure was registered during the passage through the pyloroduodenal junction and the lower esophageal sphincter. "Pressure during passage" was defined as peak pressure during the passage minus the basal pressure in the underlying segment. In addition, with the balloon maintained in a stationary position within the esophageal lumen, amplitude and period of peristaltic and rhythmic pressure oscillations were determined.

Repeated passages through the same segment were intentionally avoided to reduce mechanical "preconditioning" and cumulative stimulation of mechanosensitive afferents (stretch/tension receptors), which may induce reflex changes in sphincter tone. Only technically adequate primary recordings were analyzed and incomplete or artifact-contaminated recordings were excluded. Procedures were performed during the standard diagnostic endoscopy without sedation and without pharmacological modulation of motility.

This technique is complementary to, but not equivalent to, high-resolution manometry (HRM) or FLIP panometry. The "pressure during passage" metric reflects integrated mechanical resistance within the transition zone and is not directly interchangeable with the HRM-derived basal LES pressure or the integrated relaxation pressure (IRP).

Statistical analysis. The normality of distribution of quantitative variables was assessed using the Shapiro–Wilk test. Since most of the analyzed parameters did not follow a normal distribution, the results were presented as median and quartiles Me (Q25; Q75),

and intergroup comparisons were performed using the nonparametric Kruskal–Wallis test. When statistically significant differences were identified, pairwise post hoc analysis was conducted using Dunn's test with Bonferroni correction for multiple comparisons; adjusted p-values (p_adj) are reported. The H value reflects the magnitude of the overall intergroup differences obtained using the Kruskal–Wallis test. The Z value characterizes the degree of difference between two specific groups based on the results of post-hoc analysis using Dunn's test. The effect size was estimated using ε^2 (epsilon squared) following current guidelines for nonparametric tests (Garrocho-Rangel *et al*., 2024; Fiel Peres, 2026). Statistical significance was defined as $p < 0.05$.

AI-assisted tools were used to edit and improve the manuscript's English language and style. The authors are fully responsible for the scientific content and conclusions.

RESULTS AND DISCUSSION

Parameters of intraluminal pressure and rhythmic contractile activity of the esophagus in the study groups are presented in **Table**. Balloon pressure during the passage through the pyloroduodenal sphincter in Group I (control) was 17.58 (15.19; 20.11) mmHg, in Group II (achalasia) – 23.82 (11.02; 43.04) mmHg, and in Group III (hiatal hernia) – 28.43 (11.68; 55.68) mmHg. Pressure during the pyloroduodenal sphincter passage did not differ significantly among groups (Kruskal–Wallis H = 4.08, p = 0.13; $\varepsilon^2 = 0.011$). Therefore, no post hoc pairwise comparisons were interpreted for this outcome.

Parameters of intraluminal pressure and rhythmic contractile activity of the esophagus in the study groups

Parameter	Group I Me (Q25; Q75)	Group II Me (Q25; Q75)	Group III Me (Q25; Q75)	H	p	ε^2
Pressure during passage through the pyloroduodenal junction, mmHg	17.58 (15.19; 20.11)	23.82 (11.02; 43.04)	28.43 (11.68; 55.68)	4.08	0.13	0.011
Pressure during passage through the lower esophageal sphincter, mmHg	19.54 (18.25; 20.12)	22.80 (9.76; 43.69)	4.52 (1.30; 12.64)	51.44	$6.75 \cdot 10^{-12}$	0.25
Amplitude of the peristaltic wave, mmHg	22.94 (14.52; 28.10)	13.71 (13.00; 34.22)	23.71 (14.30; 35.33)	0.37	0.83	0.00
Period of the peristaltic wave, s	16.98 (14.75; 18.31)	12.00 (12.00; 25.00)	13.00 (11.08; 16.00)	6.59	0.037	0.074
Amplitude of rhythmic contractions, mmHg	6.35 (5.39; 9.87)	4.63 (2.75; 5.66)	5.77 (3.25; 9.90)	5.87	0.053	0.047
Period of rhythmic contractions, s	3.21 (2.90; 4.20)	3.82 (3.30; 4.49)	3.33 (2.92; 4.75)	1.58	0.45	0.00

Note: Data are reported as median (Q25; Q75). Differences among groups were analyzed using the Kruskal–Wallis test with Dunn's post hoc test and Bonferroni correction. The significance level was set at $p < 0.05$, and the effect size was estimated using ε^2

Although the median pressure recorded during the passage through the pyloroduodenal junction was higher in the hiatal hernia group than in controls (28.43 vs 17.58 mmHg), the absence of a significant overall Kruskal–Wallis result and the minimal effect size warrant treating this finding as descriptive rather than inferential. While the direction of change is broadly consistent with reports discussing a potential contribution of pyloric/pyloroduodenal dysfunction to an increased outlet resistance and altered gastric emptying, the present data do not support conclusions regarding intersegmental dyscoordination or a multisegmental motor disorder (Na *et al*., 2025; Kuhar *et al*., 2025).

Balloon pressure during the passage through the lower esophageal sphincter in Group I was 19.54 (18.25; 20.12) mmHg, in Group II – 22.80 (9.76; 43.69) mmHg, and in Group III – 4.52 (1.30; 12.64) mmHg. Intergroup comparison using the Kruskal–Wallis test revealed statistically significant differences ($H = 51.44$, $p = 6.75 \cdot 10^{-12}$) with a pronounced effect size ($\varepsilon^2 = 0.25$). Post hoc Dunn's testing showed markedly lower pressure in the hiatal hernia group compared with both controls ($p\_adj = 1.49 \cdot 10^{-5}$) and achalasia ($p\_adj = 7.77 \cdot 10^{-11}$). In contrast, the control and achalasia groups did not differ ($p\_adj = 0.997$), indicating that in this cohort, LES pressure primarily discriminated hiatal hernia from the other groups rather than achalasia from controls.

A marked reduction in pressure during the passage through the lower esophageal sphincter in patients with hiatal hernia compared with the control group likely reflects anatomical and functional compromise of the antireflux barrier associated with gastroesophageal junction displacement and a reduced basal sphincter competence, consistent with contemporary concepts of reflux pathophysiology (Patel *et al*., 2022; Yang *et al*., 2024). The higher values observed in the achalasia group relative to the hiatal hernia group may be compatible with impaired neurogenic regulation of LES relaxation described in achalasia. However, because achalasia did not differ from controls in this dataset, this finding should be interpreted cautiously and may reflect phenotypic heterogeneity, stage-dependent variability, and the fact that the present metric represents "pressure during passage" rather than standard HRM-derived indices (Patel *et al*., 2022; Vasireddy *et al*., 2025; Elmakki *et al*., 2024; Jain, 2024). Overall, the results support heterogeneous mechanisms of LES dysfunction across nosologies, with hypotonic barrier failure predominating in hiatal hernia and neurogenic relaxation impairment being pathophysiologically relevant to achalasia, while not necessarily expressed as higher LES pressure versus controls in this cohort (Hoshikawa & Iwakiri, 2024).

Intergroup comparison using the Kruskal–Wallis test did not reveal statistically significant differences ($H = 0.37$; $p = 0.83$), in the absence of an effect ($\varepsilon^2 = 0.00$).

The observed tendency toward reduced peristaltic wave amplitude in achalasia may be associated with variability in motor phenotypes and the extent of neuronal degeneration, thereby limiting the diagnostic utility of amplitude-based indicators (Yadlapati *et al*., 2021; Vespa *et al*., 2024; Hoshikawa & Iwakiri, 2024). The absence of differences between the control group and patients with HH indicates relative preservation of the propulsive function when anatomical and sphincter disorders predominate (Kayali *et al.*, 2024; Lin *et al*., 2025). In general, the amplitude of the peristaltic wave is a secondary and less specific marker compared to indicators of sphincter function.

Intergroup comparison using the Kruskal–Wallis test revealed statistically significant differences ($H = 6.59$; $p = 0.037$) with a small effect size ($\varepsilon^2 = 0.074$). According to the post-hoc analysis, a statistically significant difference was observed between groups I and III ($Z = 2.57$; $p = 0.010$), whereas the differences between groups I and II ($p = 0.29$) and II and III ($p = 0.63$) did not reach statistical significance.

The observed shortening of the peristaltic wave period in HH compared to the control may be associated with a disruption of the anatomy of the gastroesophageal junction and compensatory changes in bolus clearance, with reduced barrier function (Kayali *et al*., 2024; Lin *et al*., 2025). The tendency to decrease the period in achalasia, which does not reach statistical significance, probably reflects the heterogeneity of motor phenotypes and the variability of the preservation of neuronal mechanisms of peristalsis (Cohen *et al*., 2023; Vespa *et al*., 2024). The peristaltic wave period mainly represents regulatory and compensatory components of esophageal motility and is less specific than sphincter pressure and relaxation metrics (Mari *et al*., 2023; Parker, 2025).

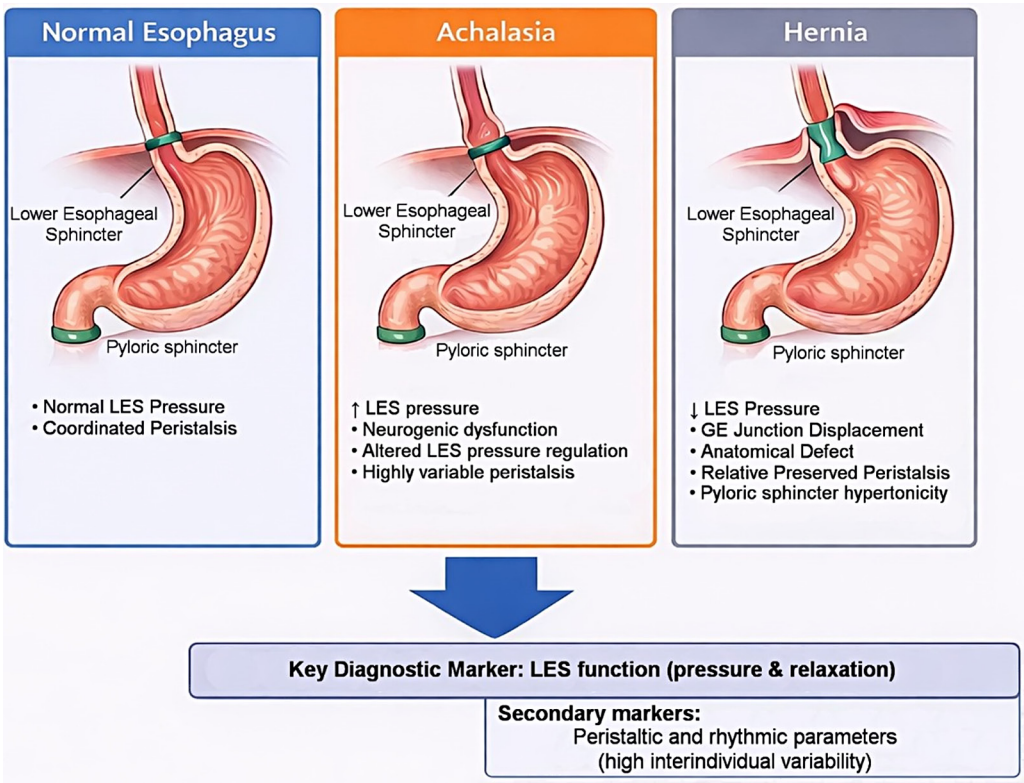
According to the results of the intergroup comparison using the Kruskal-Wallis test, no statistically significant differences were revealed ($H = 5.87$; $p = 0.053$), with a small effect size ($\varepsilon^2 = 0.047$). In a pairwise analysis using the Danna test, a statistically significant difference was established between groups I and II ($Z = 2.36$; $p = 0.018$), while the differences between groups I and III ($p = 0.25$) and II and III ($p = 0.074$) did not reach statistical significance.

Neuromuscular dysfunction and motor phenotype heterogeneity may underline the limited diagnostic value of contraction amplitude in achalasia (Kurosugi *et al*., 2024; Araujo *et al*., 2021). The absence of significant differences between the control group and patients with HH indicates the relative safety of esophageal body contractile activity in this pathology, with the gastroesophageal junction as the primary site of disturbance (Lei *et al*., 2022; Kayali *et al*., 2024). In general, the amplitude of rhythmic contractions is a secondary and less specific marker of motor disturbances compared to parameters of sphincter function (Carlson *et al*., 2015; Gyawali *et al*., 2024).

Intergroup comparison using the Kruskal-Wallis test did not reveal statistically significant differences ($H = 1.58$; $p = 0.45$), in the absence of an effect ($\varepsilon^2 = 0.005$). According to the post-hoc analysis, there were no statistically significant differences between groups I and II ($p = 0.27$), I and III ($p = 0.79$), or II and III ($p = 0.26$).

The absence of intergroup differences indicates a high variability of the period of rhythmic contractions and the absence of stable changes in this indicator in achalasia and HH. In general, the period of rhythmic contractions reflects the fundamental properties of neuromuscular regulation of the esophagus (Carlson *et al*., 2018; Baumann *et al*., 2021); however, it has a low diagnostic value compared to the parameters of contraction coordination and sphincter function (Clouse & Ferney, 1986; Carlson *et al*., 2020; Muta *et al*., 2022).

Overall, the most consistent between-group differences in this cohort were observed in sphincter-related parameters, particularly LES-region pressure during the balloon passage. Patients with hiatal hernia showed markedly lower values than both controls and patients with achalasia, which is compatible with a reduced antireflux barrier competence in HH ($H = 51.44$; $p < 0.001$; $\varepsilon^2 = 0.25$). By contrast, esophageal body peristaltic and rhythmic parameters showed a substantial dispersion and either non-significant differences or small effect sizes (ε^2 from 0 to 0.074), supporting their interpretation as secondary functional markers with limited discriminatory performance in the present sample. Importantly, these findings should not be extrapolated to “systemic” or intersegmental motor coupling because the study did not include gastric emptying, duodenal motor measurements, or coordination indices; rather, they provide a protocolized comparison of junctional pressure patterns across nosologies within the constraints of the applied method (see **Figure**).



Conceptual model of esophageal and esophagogastric junction motor dysfunction in achalasia and hiatal hernia

The scheme (**Figure**) summarizes the main group-level patterns observed in this study and a conservative interpretation consistent with the data. In this cohort, LES-region pressure most clearly separated the hiatal hernia group from both controls and achalasia, whereas achalasia did not differ from controls in this metric and therefore cannot be described here as having “elevated LES pressure” relative to the control group. Peristaltic and rhythmic parameters exhibited high variability and are presented as secondary functional markers. Accordingly, **Figure** should be interpreted as a hypothesis-generating framework for integrating the measured pressure patterns rather than as evidence of systemic or intersegmental motor dyscoordination.

Thus, the proposed conceptual model integrates the obtained quantitative findings and emphasizes sphincter-region pressure changes as the most consistent differentiating feature in this dataset, while recognizing the limited specificity of esophageal body timing/amplitude measures and the need for confirmation in larger, stratified cohorts using gold-standard motility testing.

CONCLUSION

The obtained results indicate that, within the applied protocol using a pneumatic balloon, lower esophageal sphincter (LES) pressure provided the most pronounced intergroup contrast, primarily due to the marked decrease observed in hiatal hernia, which

is consistent with compromise of the antireflux barrier. At the same time, in this cohort, LES pressure did not differ statistically significantly between the achalasia and control groups, which limits its discriminatory value for distinguishing these two groups and is consistent with the assumption that impaired LES relaxation predominates in achalasia. Parameters related to the pyloroduodenal junction did not demonstrate significant differences in the overall intergroup test and therefore, may be considered descriptive and requiring confirmation. Peristaltic and rhythmic parameters of the esophageal body were characterized by high inter-individual variability and a limited capacity for intergroup differentiation within the analyzed dataset.

Overall, the results highlight the importance of the sphincter component (primarily the LES) in differences in motor characteristics among the studied nosologies. However, they should be interpreted with caution given the single-center design, the small control group, the absence of stratification by disease subtypes, and the lack of direct validation by HRM/FLIP. From a practical perspective, considering the limited availability of HRM in routine practice due to the high cost of the examination and consumables, pneumatic balloon intraluminal pressure recording may be considered a complementary protocolized approach for quantitative assessment of sphincter zones in selected clinical settings, provided that its limitations are clearly recognized and that further verification is performed in larger, stratified studies using reference methods.

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COMPLIANCE WITH ETHICAL STANDARDS

Conflict of Interest: the authors declare no conflict of interest.

Animal studies: this study did not involve experiments on animals.

Human Rights: all procedures involving human participants were conducted in accordance with the ethical standards of the Declaration of Helsinki and were approved by the local Bioethics Committee (Protocol No 2, April 7, 2022). Informed consent was obtained from all study participants.

AUTHOR CONTRIBUTIONS

Conceptualization, [A.H.; O.S.]; methodology, [O.H.; A.H.]; software, [O.H.]; validation, [A.H.; O.S.]; formal analysis, [A.H.]; investigation, [A.H.; O.H.]; resources, [A.H.; O.H.]; data curation, [A.H.; O.H.]; writing – original draft preparation, [A.H.]; writing – review and editing, [A.H.]; visualization, [A.H.]; supervision, [O.S.]; project administration, [A.H.; O.S.]; funding acquisition, [–].

All authors have read and agreed to the published version of the manuscript.

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ОСОБЛИВОСТІ МОТОРИКИ СТРАВОХОДУ Й ЕЗОФАГОГАСТРАЛЬНОГО ПЕРЕХОДУ ЗА АХАЛАЗІЇ ТА ГРИЖ СТРАВОХІДНОГО ОТВОРУ ДІАФРАГМИ: ПОРІВНЯЛЬНЕ ДОСЛІДЖЕННЯ

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Обґрунтування. Порушення моторики езофагогастрального переходу за ахалазії та гриж стравохідного отвору діафрагми супроводжуються змінами бар'єрної функції нижнього стравохідного сфінктера і координації перистальтичних скорочень стравоходу. Кількісна реєстрація внутрішньопросвітного тиску дає змогу об'єктивізувати патофізіологічні механізми цих розладів і оцінити міжсегментарні особливості моторної регуляції.

Матеріали та методи. Обстежено 165 пацієнтів, розподілених на три групи: контрольна (n = 15), ахалазія (n = 50), грижі стравохідного отвору діафрагми (n = 100). Внутрішньопросвітний тиск реєстрували за допомогою пневматичного балона, фіксованого на ендоскопічному зонді. Оцінювали тиск у ділянці нижнього стравохідного сфінктера та пілоро-дуоденального переходу, а також амплітуду й період перистальтичних і ритмічних коливань тиску. Результати подано у вигляді Me (025; 075). Для міжгрупового порівняння застосовували критерій Краскела–Волліса з пост-хок тестом Данна з поправкою Бонферроні для множинних порівнянь.

Результати. Тиск під час проходження нижнього стравохідного сфінктера у групі гриж стравохідного отвору діафрагми становив 4,52 (1,30; 12,64) мм рт. ст.

і був статистично нижчим, ніж у групі контролю – 19,54 (18,25; 20,12) мм рт. ст. та у групі ахалазії кардії – 22,80 (9,76; 43,69) мм рт. ст. (H = 51,44; p < 0,001). Період перистальтичної хвилі був скорочений у пацієнтів із грижами порівняно з контрольною групою (p = 0,010). Амплітуда перистальтичних і ритмічних скорочень не демонструвала статистично значущих міжгрупових відмінностей. Зміни параметрів мали різноспрямований характер залежно від нозологічної форми.

Висновки. У цьому дослідженні тиск у ділянці нижнього стравохідного сфінктера, виміряний під час проходження балона, продемонстрував найбільший міжгруповий контраст, зумовлений суттєво нижчими значеннями у групі хворих із грижами стравохідного отвору діафрагми і, відповідно, забезпечив найчіткіше розмежування між групами в межах застосованого протоколу. Отриманий результат узгоджується зі зниженням функціональної спроможності антирефлюксного бар'єра у хворих із грижами стравохідного отвору діафрагми. Водночас показник "тиск під час проходження" відображає інтегральну механічну резистентність у зоні переходу та не є прямим аналогом базального тиску нижнього стравохідного сфінктера або інтегрального тиску релаксації (IRP), визначених за даними високороздільної манометрії. У групі ахалазії цей показник не відрізняв пацієнтів від осіб контрольної групи в межах даної когорти, тож його не варто інтерпретувати як самостійний маркер порушення релаксації нижнього стравохідного сфінктера. Перистальтична та ритмічна активність тіла стравоходу демонструє високу варіабельність і обмежену діагностичну специфічність.

Ключові слова: порушення моторики стравоходу, нижній стравохідний сфінктер, антирефлюксний бар'єр, ахалазія, грижа стравохідного отвору діафрагми, ритмічна активність стравоходу

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