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Direct cost variance analysis of peroral endoscopic myotomy vs Heller myotomy for management of achalasia: A tertiary referral center experience

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Retrospective Cohort Study

Direct cost variance analysis of peroral endoscopic myotomy vs heller myotomy for management of achalasia: A tertiary referral center experience

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Abstract

BACKGROUND

Laparoscopic Heller myotomy (LHM) has been the traditional surgical treatment for achalasia. Recently, peroral endoscopic myotomy (POEM) has demonstrated similar clinical outcomes with shorter procedure times. Studies comparing the direct cost-effectiveness of POEM *vs* LHM are limited.

AIM

To compare costs of POEM *vs* LHM.

METHODS

This retrospective chart review aimed to compare the outcomes and cost of clinical care between patients who underwent POEM and LHM procedures for achalasia. The study was conducted at a tertiary academic center from January 2019 to December 2020. Clinical outcomes, including post-operative Eckardt scores and adverse events, were assessed and compared between the two groups. Direct cost variance analysis was utilized to evaluate the cost of clinical care incurred by patients undergoing POEM in the year preceding the procedure, during the index admission, and one year post-procedure, in comparison to patients undergoing LHM.

RESULTS

Of 30 patients were included (15 POEM and 15 LHM) in the study. Patients in the POEM group had a mean Eckardt score of 0.5 ± 0.5 post-procedure, which was no different from patients in the LHM group (0.7 ± 0.6 , $P = 0.17$) indicating comparative efficacy. However, the total costs of the admission for the procedure in the LHM group were on average \$1827 more expensive than in the POEM group ($P < 0.01$). Total healthcare costs one year prior to index procedure were \$7777 higher in the LHM group, but not statistically different ($P = 0.34$). The patients in the LHM group one year after the index procedure had accrued \$19730.24 larger total cost, although this was not statistically different from POEM group ($P = 0.68$).

CONCLUSION

Despite similar clinical outcomes, the cost of the index procedure admission for POEM was significantly lower than for LHM. The difference was primarily related to shorter time increments utilized in the operating room during the index procedure, and shorter length of hospital stay following POEM.

Key Words: Peroral endoscopic myotomy; Cost analysis; Laparoscopic Heller myotomy; Achalasia

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Core Tip: This manuscript focuses on comparing the clinical outcomes and costs of laparoscopic Heller myotomy (LHM) and peroral endoscopic myotomy (POEM) as treatment options for achalasia, a rare esophageal motility disorder. Achalasia is characterized by impaired relaxation of the lower esophageal sphincter and abnormal peristalsis in the esophageal body, resulting in symptoms such as dysphagia, regurgitation, chest pain, and weight loss. The study aims to determine the clinical efficacy and cost-effectiveness of both procedures. By analyzing data from a tertiary-academic referral center, the researchers investigate the clinical outcomes, costs prior to and following the procedure, and adverse events associated with LHM and POEM.

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INTRODUCTION

Achalasia is a rare, idiopathic esophageal motility disorder characterized by impaired relaxation of the lower esophageal sphincter (LES) and abnormal smooth muscle peristalsis in the esophageal body[1-3]. Typical symptoms consist of dysphagia, regurgitation of food from the esophagus, chest pain and weight loss, resulting from incomplete transfer of nutrients past the LES[2,4,5]. Definitive management requires disruption of the obstructive LES, traditionally performed endoscopically as pneumatic dilation (PD) or surgically as laparoscopic Heller myotomy (LHM)[2]. More recently, peroral endoscopic myotomy (POEM) has become available with increasing utilization in the last decade[3,6,7]. Clinical success was similar between patients undergoing either procedure at two years, however, serious adverse events were more frequent in patients undergoing LHM with acid reflux being a more common symptoms in patients undergoing POEM[6].

Considering that escalating healthcare costs represent a large economic burden to the patients and society, comparative cost-effectiveness may be the eventual driver of which management option is a preferred treatment option. The aim of this study was to compare clinical outcomes, costs one-year prior to the procedure, during the index admission, and one-year after the procedure between LHM and POEM at a tertiary-academic referral center where both options were available.

MATERIALS AND METHODS

Data source and population

Clinical data was obtained retrospectively from chart review of the University of Kentucky Medical Center electronic medical record (EMR). Cases were identified by interrogating the EMR for adult patients (age > 18 years) with dysphagia and achalasia based on International Classification of Diseases-10 (ICD-10) codes (K22.0, R13.10), and abstracting all patients treated with POEM or LHM between January 2019 and December 2020. Patients with prior foregut surgery, patients without manometrically confirmed achalasia, and those without healthcare encounters at our hospital system one year before and after the index procedure were excluded. Sixteen patients underwent POEM and another sixteen subjects had LHM within the same timeframe (maximum 24-mo interval) to minimize cost variability over time. POEM was performed by a trained interventional endoscopist who performed at least 20 procedures prior to the study period and LHM was performed by a trained cardiothoracic surgeon who performed at least 20 procedures prior to the study period. The decision to undergo either POEM or LHM and thus allocation to either group was a function of insurance coverage, patient preference, and provider type (gastroenterologist or surgeon) and was performed without randomization. Given the retrospective nature of the study, the full logic behind allocation was influenced by various factors and could not be fully detailed due to the complexity and individualized nature of patient decision-making processes. The finance office at our institution provided cost data for each procedure.

The study protocol and data analysis described was approved by the University of Kentucky Institutional Review Board (IRB). A waiver of informed consent was granted as the study retrospectively evaluated de-identified data. All data security safeguards were strictly followed as per IRB policy.

LHM and POEM protocol

Pre-operative protocol for both LHM and POEM were similar. All patients in both groups underwent pre-procedural esophagram, esophagogastroduodenoscopy (EGD) to rule out pseudo-achalasia, diagnosis with manometry study, pre-operative clinical visits with the performing endoscopist or surgeon, as well as a pre-operative anesthesia visit.

The procedure technique employed for both LHM and POEM have been described elsewhere[8,9]. All patients in the LHM group underwent Dor or Toupet fundoplication. General anesthesia was used for all cases, and all patients were subsequently admitted for at least one night for post-op recovery and observation. All POEM procedures were performed in the operating room (OR). Procedural technique for POEM involved a mix of anterior and posterior approaches. All patients were scheduled at the 1, 6, and 12 mo time points in clinic for follow up, and all were evaluated with post-operative gastrografin study to evaluate for leak. Follow up EGD, manometry and pH studies were performed dependent on patient symptomatology and recovery.

Variables and outcomes

For the patients in the study, clinical variables were extracted from review of EMR. Demographic information, disease characteristics (subtype of achalasia, duration of symptoms, symptomatology, previous therapies), and intervention-related variables (efficacy: Pre- and post-intervention Eckardt score, length of stay for the index procedure, complications, readmission, time to last follow up visit) were extracted. Eckardt score was calculated as a total score of four symptom components: Dysphagia, regurgitation, chest pain, and weight loss, on 4 point Likert scales (0 = none, 3 = with every meal or severe)[10]. Costs incurred were reviewed from one year prior to index procedure, during index admission, and one-year post-procedure. Clinical success was defined as Eckardt score < 3 after POEM or LHM. Procedure related adverse events were recorded and categorized per published American Society for Gastrointestinal Endoscopy criteria[11]. Adverse events were identified by chart review, including clinical encounters, index and subsequent hospitalizations, as well as ER visits at our institution within one year of the index admission.

Cost data collection

Due to variance in reimbursement rates, we elected to use healthcare charges as a surrogate for the cost for each patient. All achalasia-related charges billed by the institution's hospital network system were obtained for one-year prior to the index admission, the index procedure admission, and one-year following the index admission. Costs derived from achalasia diagnosis and management were identified by manual review of each medical charge for both inpatient and outpatient encounters. This review was conducted by one of the study authors (Haider SA) for the period one-year prior and one year following the procedure. In addition to encounters with ICD-10 codes K22.0 "Achalasia of Esophagus" and R13.10 "Dysphagia Unspecified", other medical encounters with diagnoses including to A41.9 "Sepsis, Unspecified Organism", K22.5 "Diverticulum of Esophagus Acquired", R11.10 "Vomiting Unspecified", R07.89 "Other Chest Pain", J18.9 "pneumonia", and J90.0 "pleural effusion" were reviewed to determine the relationship to the index procedure. ICD codes were selected based on previous literature, to capture costs of the most commonly encountered adverse events related to the index procedure[12]. Encounters included ER visits, pre-surgical anesthesia evaluations, gastroenterology clinic visits, subsequent testing for monitoring of symptoms, primary care visits, and inpatient admissions were independently reviewed to determine relationship to the index procedure. Temporality to the index procedure, existing medical comorbidities, laboratory/imaging data, and provider assessment notes were considered in determining whether each healthcare encounter was attributable to the index procedure. Encounters unrelated to achalasia or the index procedure were excluded from the analysis.

The admission charge categories included anesthesia, electrocardiographic/telemetry, laboratory, surgical supplies, OR services (labor), time spent in intensive care unit (ICU)/observation, ancillary services, cardiac services, other specialty diagnostic services, other surgical services, pharmacy and intravenous therapy, physical therapy, respiratory

therapy services, inpatient accommodations, and radiology. A detailed breakdown of each cost category and associated charges can be found in [Supplementary Table 1](#).

Statistical analysis

Means and standard deviations (SD) are the main statistical parameters in the analysis. Pearson χ^2 and Fisher's exact tests were used as appropriate to analyze the association between categorical variables. Two sample *t*-tests were used to compare independent continuous variables. To apply the two-tailed *t*-test, *F*-test for comparing the variances of two groups was used to determine if the two groups had equal variances. Paired *t*-tests were used to compare dependent variables. Confidence intervals are described as means \pm one standard error. Total direct cost variance was calculated by totaling each charge category and then calculating the difference between the POEM and LHM group. Average cost variance was determined by calculating the mean for each charge category in the POEM and LHM group and then calculating the difference. The level of statistical significance used was 0.05. All analyses were performed in R version 3.6.3. The statistical methods of this study were reviewed Doaa Ali, MD, PhD, from the University of Kentucky.

RESULTS

Baseline characteristics

Of 30 patients, (mean age 54.2 and 52.6 in POEM and LHM group, respectively) were included in the study (15 underwent POEM and 15 LHM). Two patients, one who underwent LHM and one who underwent POEM in the study period, were excluded due to a lack of follow up and having undergone previous foregut surgery. Baseline characteristics including age, gender and weight were similar in the LHM and POEM cohorts ($P \geq 0.7$) ([Table 1](#)). Additionally, duration of symptoms ($P = 0.78$), achalasia subtypes ($P = 0.7$), proportions with prior botulinum toxin injection ($P = 0.7$) or PD ($P = 1.0$) as well as symptom severity as measured by the Eckardt score ($P = 0.24$), and symptoms score >2 ($P \geq 0.7$) were similar in both groups.

Clinical outcomes

Clinical success was seen in 15/15, 100% with POEM and in 14/15, 93% after LHM ($P = 0.98$). Post-procedure Eckardt score decreased from 7.0 (± 2.9) to 0.5 (± 0.5) in POEM group and from 5.8 (± 2.6) to 0.7 (± 0.6) in LHM group ([Table 1](#)). There was no statistically significant difference between the groups ($P = 0.17$) ([Table 2](#)), indicating that both procedures were equally effective in improving achalasia symptoms. Mean procedure time (range) was 82.3 min (66 min to 172 min) for POEM and 183 min (145 to 342 min) for LHM, $P = 0.02$. Adverse events occurred in 2/15, 13.3% with POEM and in 4/15, 26.6% after LHM, ($P = 0.65$). Severe (serious) adverse events were experienced in one patient in the POEM group, and in one patient in the LHM group. One patient in both groups required a subsequent ICU stay. Though numerically higher in the LHM group, adverse events and readmission rates were statistically similar ($P \geq 0.6$) between the two groups. Adverse events in the LHM group ($n = 4$) included urinary retention, nausea and vomiting, unexplained diarrhea, aspiration pneumonia with sepsis; one patient with sepsis succumbed to illness. Adverse events in the POEM group ($n = 2$) included pneumomediastinum, and aspiration pneumonia with resultant lung abscess requiring thoracotomy. The patient requiring thoracotomy and lung abscess required 2 d in the ICU, however, was able to go home on IV antibiotics and subsequently recovered. Length of stay was significantly longer in the LHM group (2.26 ± 0.6 d) compared to the POEM group (1.1 ± 0.3 d, $P < 0.01$), and this was partly driven by a prolonged hospital stay associated with aspiration pneumonia and sepsis in one patient.

Costs

The average admission cost following LHM was \$1828 more expensive than for POEM group ($P < 0.01$, [Table 3](#)). The majority of the cost difference were accounted by OR services, which were \$545 higher ($P < 0.01$) per case in the LHM group. The other significant areas of cost difference between LHM and POEM were time spent in ICU/observation (\$185), pharmacy and IV therapy (\$124), and physical therapy (\$15) ($P \leq 0.03$ for each comparison). The X-ray costs were more expensive with POEM group ($P < 0.01$). Anesthesia costs tended to be \$88 per case higher in the LHM group vs the POEM group ($P = 0.05$). The LHM group required 10.2 additional 15 min unit charges on average for anesthesia, while the POEM group required 5.2 additional 15 min unit charges ([Supplementary Table 1](#)). Other comparisons did not demonstrate significant differences ([Table 3](#)). The patients had no difference in cost 1 year prior to index procedure ($P = 0.34$), and there was no difference in cost 1 year after the index procedure ($P = 0.68$).

DISCUSSION

Over the last decade numerous studies have shown the efficacy of POEM independently and in comparison to LHM for management of achalasia, with similar dysphagia improvement and patient-reported satisfaction[3,13,14]. Since cost of the therapy is another key metric when two therapies are assessed, we compared the index admission costs, as well as costs 1 year prior and 1 year following the procedure between patients undergoing LHM and POEM at a tertiary care center. We demonstrate that the cost of index admission for the procedure is significantly less expensive in patients undergoing POEM compared to LHM, despite similar costs during the year leading up to the procedure, as well as during the year following the procedure. The procedure related costs and duration of hospital stay also favored POEM

Table 1 Baseline characteristics of peroral endoscopic myotomy and laparoscopic Heller myotomy patients at time of intervention

	POEM (n = 15)	LHM (n = 15)	P value
Mean age in years (SD)	54.2 (8.6)	52.6 (7.3)	0.74
Gender (% female)	53	53	1.0
Mean weight (lbs, standard deviation)	183.3 (47)	188.4 (25.3)	0.26
Mean duration of symptoms (yr, SD)	7.1 (6.8)	7.3 (7.1)	0.78
Achalasia subtype ¹	4/7/3/1	4/8/1/2	0.70
Prior botulinum toxin	4	3	0.70
Pneumatic dilation	7	7	1.0
Mean Eckardt score (SD)	7.0 (2.9)	5.8 (2.6)	0.25
Symptom Score > 2, %			
Weight loss	67	73	1
Dysphagia	73	73	1
Regurgitation	67	80	0.67
Chest pain	20	20	1

¹Type 1/type 2/type 3/hypercontractile esophagus.

POEM: Peroral endoscopic myotomy; LHM: Laparoscopic Heller myotomy.

Table 2 Patient outcomes following peroral endoscopic myotomy and laparoscopic Heller myotomy

	POEM (n = 15)	LHM (n = 15)	P value
Post-procedure Eckardt Scores mean (SD)	0.5 (0.5)	0.7 (0.6)	0.17
Adverse events (n, %)	2, 13.3%	4, 26.7%	0.65
Readmission rate (% of patients with readmission within one year)	6.7%	20.0%	0.59
LOS mean days (SD)	1.1 (0.3)	2.26 (0.6)	< 0.01 ^a

^aDenotes statistical significance at *P*-value < 0.05.

LOS: Length of stay; POEM: Peroral endoscopic myotomy; LHM: Laparoscopic Heller myotomy.

over LHM, with similar symptom resolution and patient outcomes, further supporting use of POEM as a standard option in the management of achalasia. It is important to underscore that the primary objective of this study was to juxtapose short-term costs within the post-procedure timeframe, while acknowledging the need for subsequent research to delve into the divergence of costs over a longer-term horizon (exceeding 1 year).

Previous cost-effectiveness analyses have favored endoscopic management options, such as PD demonstrating lower costs and better cost-effectiveness compared to LHM[6,15]. Prior cost-effectiveness analysis demonstrated similar rates between LHM and POEM[15]. In this study, Miller *et al*[15] report that POEM costs 1.058 times the cost of LHM, primarily since POEM was assigned a higher cost per minute of OR and anesthesia time, despite the fact that POEM procedures are less complex for the OR team. The increased cost per minute of POEM was attributed to POEM being an investigational procedure in the study design requiring IRB approval[15]. In our study, POEM was not considered investigational which could explain the lower costs. Greenleaf *et al*[6] conducted a cost-utility analysis and found similar costs in the index admission of patients undergoing POEM *vs* LHM (\$8630 ± \$2653 *vs* \$7604 ± \$2091), with no difference in mean QALYs. However, at a willingness-to-pay threshold of \$100000, there was a 68.31% probability that POEM was cost-effective relative to LHM[6]. Furthermore, a recent Brazilian cost-utility study performed utilizing a bottom-up cost analysis found POEM to cost twice as much in the interoperative period *vs* LHM[11]. This was explained by the authors to be secondary to the disposable nature of endoscopic materials, and the use of depreciated equipment[16]. However, institution-dependent variables limit the generalizability of this evidence, hence comparisons incorporating non-operative costs and various institutional per unit costs was deemed necessary to further understand the cost differences and cost-effectiveness.

In our study, costs from procedure-related admission were on average \$1828 less expensive with POEM compared to LHM (*P* < 0.01). This was mainly accounted by OR charge categories that were functions of time to complete both procedures appeared to be the primary driver of this difference. For instance, OR labor costs, measured by activity-based costing, was \$544 more expensive per case in the LHM group (*P* < 0.01 compared to POEM). Anesthesia costs, also

Table 3 Comparison of costs

Cost category	Total direct cost variance (LHM - POEM)	Average total direct cost variance	P value
Total direct cost variance of index admission	\$27417	\$1827.81	< 0.01
Anesthesia	\$1322 ± 14	\$88.10	0.05
EKG/telemetry	\$5 ± 5	\$0.3 ± 8	0.08
Laboratory	\$1047 ± 32	\$70 ± 116	0.05
Medical surgical supplies	\$8297 ± 848	\$553 ± 649	0.07
Pre-operative costs	\$67 ± 17	\$5 ± 13	0.84
OR services	\$8169 ± 326	\$545 ± 404	< 0.01
Time spent in ICU/observation	\$2781 ± 303	\$185 ± 509	< 0.01
Ancillary services	\$166 ± 12	\$11 ± 22	0.18
Cardiac services	\$107 ± 4	\$7 ± 10	0.13
Specialty diagnostic services	\$25 ± 0.3	\$2 ± 0.3	0.12
PACU costs	\$70 ± 78	\$46 ± 49	0.74
Pharmacy and IV therapy	\$1860 ± 33	\$124 ± 130	< 0.01
Physical therapy	\$223 ± 13	\$15 ± 1	< 0.01
Respiratory	\$71 ± 71	\$5 ± 65	0.76
Routine accommodations	\$4377 ± 431	\$292 ± 461	0.75
X-Ray	\$1.117 ± 37	\$75 ± 66	< 0.01
1 yr prior to index procedure	\$7777	\$513	0.34
1 yr after index procedure	\$19730	\$1315	0.68

Costs are rounded to the nearest dollar value whenever possible. POEM: Peroral endoscopic myotomy; LHM: Laparoscopic Heller myotomy; EKG: Electrocardiographic; OR: Operating room; ICU: Intensive care unit; PACU: Postanesthesia care unit.

measured by activity-based costing, were \$88.10 higher ($P = 0.05$ compared to POEM). The units for each of these charge categories were functions of time, measured by incremental 15 min time blocks required to complete the procedure. Additionally, the procedure time was longer for LHM compared to POEM, thus requiring increased amount of variable cost resources such as labor utilization. Paradoxically, Miller *et al*[15] found the cost per minute for POEM procedures to be higher than LHM, further highlighting the variance in institutional charge/cost burden for these procedures. Additional charge categories that were higher in the LHM group included ICU costs, pharmacy costs, and laboratory costs, likely directly related to length of stay, which was significantly longer in the LHM group.

Our study reinforces the existing findings in terms of clinical effectiveness between POEM and LHM in the first year of follow up. Despite similar complication rates, patients undergoing LHM had accrued almost \$20000 more total costs than those undergoing POEM in the year following the index procedure. Some of these costs related to prolonged hospital stays for management of complications, especially intensive care requirements in the LHM group.

The strength of our study lies in the detailed cost analysis performed, including assessment of time based OR and anesthesia costs, in addition to standard clinical outcomes and length of stay, in comparing cost-effectiveness between LHM and POEM. However, our study suffers from limitations that are inherent to retrospective studies. The procedures were performed based on the best clinical judgement, and individual patient characteristics could have impacted some of the clinical outcomes and cost metrics compared, thus introducing selection bias. Despite the patients having similar severity of achalasia symptoms, we are unsure if the patients with more severe medical complications were encouraged to have LHM vs POEM. However, we would suspect that the patients with more severe comorbidities would be advised to undergo less invasive endoscopic intervention, which could increase the cost associated with POEM. There was no matching between groups. It was coincidence that fifteen patients underwent POEM and fifteen underwent LHM in each group during the study time frame. Another limitation is that work-up and follow up performed outside of our institution may not have been uniformly captured. We did not have enough patients to compare cost differences between individual achalasia subtypes, as the longer myotomy needed for type 3 achalasia and esophageal body spastic disorders could generate longer procedure times for POEM, for instance. Additional research conducted across different institutions is essential to ascertain the applicability and broader relevance of our findings, considering the potential disparities in cost-charge ratios and charge valuations inherent to diverse institutions. Moreover, it is prudent to underscore the need for further studies, particularly those encompassing larger sample sizes and extended follow-up time frames. These studies would enable a comprehensive assessment of the lasting viability of our results, while also delving into the

potential variations in costs that emerge over the long term, especially concerning the heightened prevalence of gastric reflux among patients undergoing POEM.

CONCLUSION

In conclusion, we demonstrate similar effectiveness but lower costs for POEM *vs* LHM for the management of achalasia. The difference is primarily related to shorter time increments utilized in the OR during the index procedure, and shorter length of hospital stay following POEM. As POEM becomes more commonly performed in endoscopy suites *vs* OR, we speculate that costs will continue to decline. Further prospective studies are needed to determine whether POEM should be offered preferentially over LHM in the management of achalasia. Despite similar clinical outcomes, the cost of the index procedure admission for POEM was significantly lower than for LHM.

ARTICLE HIGHLIGHTS

Research background

Laparoscopic Heller myotomy (LHM) and peroral endoscopic myotomy (POEM) are two effective procedures for treating achalasia. Given the rising healthcare costs and their impact on patients and society, comparing their cost-effectiveness becomes crucial in determining the preferred management option. This research contrasts the initial procedure and short-term (1-year) costs of both techniques at a tertiary academic care center.

Research motivation

This study focuses on comparing the clinical outcomes and costs of LHM and POEM as treatments for achalasia. The key issue addressed is the lack of direct cost-effectiveness comparisons between these procedures despite their similar clinical efficacy. By demonstrating that POEM is not only clinically effective but also economically favorable due to shorter procedure times and hospital stays, this research contributes valuable insights for guiding future decisions in the management of achalasia, highlighting the importance of considering both clinical outcomes and cost factors in selecting treatment options.

Research objectives

This study's primary aim was to compare clinical outcomes and costs between LHM and POEM for achalasia. The achieved objectives include demonstrating equivalent clinical efficacy and revealing cost advantages associated with POEM, attributed to shorter procedure times and hospital stays. These realized goals provide crucial insights for future research, emphasizing the need to consider both clinical effectiveness and economic implications when making treatment decisions for achalasia.

Research methods

The study employed a retrospective chart review method to achieve its objectives. Patient data from electronic medical records were analyzed to compare clinical outcomes and costs of LHM and POEM for achalasia. Novel aspects of the research methods included a detailed cost analysis that incorporated time-based operating room (OR) and anesthesia costs, along with a comprehensive examination of various cost categories. This approach provides a unique perspective on cost-effectiveness, highlighting the potential impact of shorter procedure times and hospital stays on overall costs.

Research results

The research findings underscored the comparable clinical efficacy of LHM and POEM for achalasia treatment, as evidenced by similar post-procedure Eckardt scores. Importantly, the study revealed a significant cost advantage of POEM over LHM, primarily attributed to shorter procedure times and hospital stays. This cost-effectiveness insight provides a valuable contribution to the field, highlighting the need for a holistic approach to treatment decisions. While the study addressed the immediate costs associated with the procedures, future research should delve into long-term cost patterns and their implications.

Research conclusions

The innovative aspect lies in its detailed cost analysis, incorporating time-based OR and anesthesia costs, and its emphasis on considering both clinical effectiveness and economic implications when making treatment decisions. While not introducing new methods, the study's novelty comes from its comprehensive examination of cost categories and the recognition of the significance of shorter procedure times and hospital stays in influencing cost-effectiveness.

Research perspectives

The direction of future research in this field should encompass larger prospective studies with extended follow-up periods to validate the long-term cost-effectiveness and clinical outcomes of LHM and POEM procedures for achalasia. Additionally, investigating the evolving costs as POEM becomes more commonplace in endoscopy suites, as well as exploring variations in costs associated with individual achalasia subtypes, could provide valuable insights for informed

treatment decisions.

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FOOTNOTES

Author contributions: Haider SA conducted primary data collection, performed data analysis, and took the lead in drafting the initial manuscript; Gyawali CP, Miller J, Softic S, and Wagh MS provided support in drafting the manuscript; Bills GS and Laoveeravat P participated in data collection, and also contributed to the study design; Gabr M played a role in shaping the overall study design, aiding in data collection, drafting the manuscript, and providing project leadership.

Institutional review board statement: The study protocol and data analysis described was approved by the University of Kentucky Institutional Review Board.

Informed consent statement: Given the retrospective nature of our study, informed consent was waived in concordance with University of Kentucky's Institutional Review Board.

Conflict-of-interest statement: All the authors report no relevant conflicts of interest for this article.

Data sharing statement: Technical appendix, statistical code, and dataset related to the manuscript titled "Comparative Analysis of Laparoscopic Heller Myotomy and Per-oral Endoscopic Myotomy for Achalasia Treatment" are available from the corresponding author at rha275@uky.edu. Informed consent was waived by the Institutional Review Board, and the presented data have been anonymized to minimize the risk of identification. The potential benefits of sharing these data outweigh the potential harms as the data contribute to scientific understanding and informed decision-making in the field of gastroenterology.

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