Revista Española de Enfermedades Digestivas
The Spanish Journal of Gastroenterology

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DOI: 10.17235/reed.2026.11806/2025
Link: PubMed (Epub ahead of print)

Please cite this article as:
Benites Harold, Kahaleh Michel , Wong Luis, Muñoz-González Raquel, Guarner-Argente Carlos , Albeniz Eduardo, Uchima Hugo. Peroral plication for end-stage esophageal achalasia and delayed gastric conduit emptying after esophagectomy – A systematic review of case series and case reports. Rev Esp Enferm Dig 2026. doi: 10.17235/reed.2026.11806/2025.

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Per-oral Plication for End-Stage Esophageal Achalasia and Delayed Gastric Conduit Emptying after esophagectomy: A Systematic Review of Case Series and Case Reports

Clinical Problem:

End-stage esophageal achalasia

Delayed gastric conduit emptying after esophagectomy

- Marked dilatation and stasis
- Aspiration risk and malnutrition
- Limited therapeutic options

Key Message:

POPE appears technically feasible and may provide symptomatic benefit in selected patients with refractory sump formation.

- Evidence is limited to early clinical experience (case series and case reports).
- Prospective studies and standardized outcomes are needed.

Intervention

POPE (Per-oral plication of the esophagus)
Endoscopic suturing technique for sump remodeling

Systematic review including 4 case series and 3 case reports

7 studies (full-text only): 39 patients
Mean age: 69.3 ± 8.4 years | Female: 54%

Results (full-text only)

Technical success: 39/39 (100%)
Clinical improvement: 31/39 (79.5%)
- Achalasia: 25/30 (83.3%)
- Post-esophagectomy DGCE: 6/9 (66.7%)

Reintervention (re-POPE): 12/39 (30.8%)
Adverse events: 5/39 (12.8%)
No procedure-related mortality reported

Revista Española de Enfermedades Digestivas (REED)
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Peroral plication for end-stage esophageal achalasia and delayed gastric conduit emptying after esophagectomy – A systematic review of case series and case reports

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List of abbreviations:

POPE: Peroral plication of the esophagus

DGCE: Delayed gastric conduit emptying

POEM: Peroral endoscopic myotomy

POP: Peroral pyloromyotomy

SEMS: Self-expandable metallic stent

JBI: Joanna Briggs Institute

GRADE: Grading of Recommendations Assessment, Development and Evaluation

SD: Standard deviation

NA: Not available

Abstract

Introduction: Sump formation can occur in end-stage esophageal achalasia or following esophagectomy and is associated with severe esophageal dilatation, luminal stasis, increased aspiration risk, and malnutrition. Peroral plication of the esophagus (POPE) is a novel endoscopic technique designed to remodel the esophageal lumen; however, current evidence remains limited. This systematic review assesses the available evidence on POPE in patients with end-stage achalasia and delayed gastric conduit emptying (DGCE) after esophagectomy.

Methods: This systematic review was conducted across four databases. Case series and case reports describing POPE in patients with achalasia or postesophagectomy were included to evaluate feasibility, clinical outcomes, and safety. Conference abstracts were included only when sufficient data on key outcomes could be extracted. The main analysis was limited to full-text publications, with a secondary analysis incorporating conference abstracts. Certainty of evidence was assessed using an adapted GRADE approach based on full-text studies.

Results: Nine studies were included, comprising 59 patients (four case series, three case reports, and two conference abstracts). The primary analysis, including 39 patients, revealed technical success and symptom improvement in 39/39 (100%) and 31/39 patients (79.5%), respectively. A new session of POPE (re-POPE) was performed in 12/39 patients (30.8%). No intraprocedural adverse events occurred, and 5/39 cases

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exhibited postprocedural adverse events (12.8%). When conference abstracts (59 patients) were included, technical success was reported in all patients (100%), with symptom improvement in 51/59 (86.4%). The secondary analysis demonstrated that re-POPE was performed in 13/59 patients (22.0%).

Conclusions: POPE appears to be a feasible intervention with an acceptable safety profile based on published case reports and series and may provide symptomatic benefit in selected patients. However, current evidence is limited and heterogeneous. Prospective studies and multicenter registries with standardized results are needed to confirm its efficacy and durability.

Keywords: Esophageal achalasia. Esophagectomy. Endoscopy. Systematic review.

Introduction

Esophageal achalasia may progress to an end-stage disease, characterized by massive dilation of the esophagus (megaesophagus) or marked tortuosity (sigmoid esophagus)[1], and is associated with a lower clinical response to cardia myotomy.[2] The decreased response may be associated with sump formation (areas where food content accumulates), which can worsen dysphagia, promote further weight loss, and increase the risk of aspiration pneumonia.[3]

Esophagectomy has traditionally been considered a treatment option for these patients, with high morbidity and mortality rates.[1,4] However, less-invasive alternatives that modify the esophageal anatomy have been described as an alternative to surgery. Peroral plication of the esophagus (POPE), performed with endoscopic suturing, is a novel endoscopic approach comprising esophageal remodeling to reduce its dilation and tortuosity (sump formation) and has been proposed as a method to improve esophageal emptying.[5]

Post-esophagectomy, the incidence of early delayed gastric conduit emptying (DGCE) has been reported as 15.9%, and late DGCE as 9.4%.[6–9] This condition may be caused by vagal nerve transection, gastric conduit realignment, or pressure-gradient changes. Reported treatment options include botulinum toxin injection, endoscopic dilation,

peroral pyloromyotomy (POP), and laparoscopic pyloroplasty.[10] In patients with refractory DGCE due to "sump" formation, POPE has been proposed as a potential endoscopic option before surgical reintervention in selected cases.

Reports and small case series indicate potential clinical benefits of POPE for these conditions; however, the available evidence remains limited. Therefore, this systematic review critically evaluates the current literature of published POPE cases in patients with end-stage achalasia and DGCE after esophagectomy, assessing feasibility, clinical outcomes, and safety.

Methods

This review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses reporting guidelines[11] and was registered on the PROSPERO database (CRD420251102389).

Search strategy

Four electronic databases (PubMed, Embase, Scopus, and Web of Science) were searched from inception to July 31, 2025. Key terms included "Esophagectomy," "Esophageal Achalasia," Gastric Emptying," and "Endoscopic Treatment." The complete search strategy is shown in Table 1. No restrictions were applied regarding language or publication date. Additionally, the reference lists of all included articles and relevant reviews were searched manually to identify additional studies.

Eligibility criteria

We included studies that reported patients undergoing POPE for end-stage achalasia or DGCE after esophagectomy with extractable clinical information regarding patient characteristics, procedural details, clinical outcomes, adverse events, and follow-up. Editorials, commentaries, systematic reviews, and narrative reviews were excluded.

Conference abstracts were included, given the limited full-text evidence available for this emerging technique. Abstracts were included only when extractable denominators for key outcomes were available.

Study selection

Articles were downloaded from an electronic search into the EndNote X8 software. After removing duplicate records, selected studies were uploaded to Rayyan QCRI (https://rayyan.qcri.org/). Two authors screened the studies (HB and HU). Disagreements were resolved through discussion and consensus.

Data extraction

Two reviewers (HB and HU) independently extracted data on a previously designed Microsoft Excel® spreadsheet. Any discrepancies were resolved by consensus.

Variable definition

Technical success refers to the completion of the procedure independently of the clinical response. Clinical response was defined as any degree of clinical improvement, including both complete and partial symptomatic improvement (as reported by each study). If the Eckardt score was described, any score improvement was considered a clinical response. The description of the Eckardt score (evaluating dysphagia, regurgitation, retrosternal pain, and weight loss) was not considered mandatory, as this score might underestimate the severity of the "sump" formation (e.g., the regurgitation or oral intolerance may not yield more than 3 points on the Eckardt score).

Intra- and postprocedural adverse events were defined if it happened during the POPE procedure or after completing the procedure. A major adverse event required any additional intervention (e.g., endoscopic, surgical treatment, or antibiotics), whereas a minor adverse event did not require additional intervention.

Quality assessment

To assess the risk-of-bias in case reports and case series, the Joanna Briggs Institute (JBI) Critical Appraisal Checklists was employed when possible.[12] For each study, item-level responses were recorded as "Yes," "No," "Unclear," or "Not applicable." An

overall risk-of-bias classification was created by calculating the proportion of "Yes" responses among applicable items (excluding "Not applicable"). The risk-of-bias of studies with <50% "Yes" responses was classified as high, whereas those with ≥50% "Yes" responses were classified as low-to-moderate. Conference abstracts were not formally assessed due to insufficient reporting to enable reliable item-level appraisal.

Data synthesis

Categorical variables were presented using frequencies and percentages. Continuous variables were expressed as means with standard deviations or medians with interquartile ranges, depending on data availability. The primary descriptive analysis was performed using full-text publications. A complementary analysis including conference abstracts and recalculated technical success, clinical response, repeat POPE (re-POPE) rate, and adverse events was also conducted. All analyses were performed using R 3.6.3 (R Foundation for Statistical Computing, Vienna, Austria).

Certainty of evidence

Certainty of evidence was rated using an adapted GRADE approach for narrative syntheses, as previously proposed for situations where meta-analysis is not feasible.[13] Given the exclusively noncomparative nature of the evidence, the certainty of evidence was rated as very low for all outcomes.

Results

Study selection

The electronic search strategy initially identified 729 articles (PubMed, 430; Embase, 198; Scopus, 72; Web of Science, 29). After removing duplicates, 591 articles remained. After screening studies by title/abstract, 582 articles were excluded. After the full-text assessment of nine articles, one was excluded due to an ineligible publication type (book chapter). One record was also retrieved from manual searching. Finally, nine publications were included in the review, comprising four case series,[14–17] three case reports,[5,18,19] and two conference abstracts,[20,21] with a combined population of 59 patients (Figure 1).

The risk-of-bias was assessed in the seven full-text studies. Item-level JBI assessments for each study are presented in Tables 2 and 3. Overall, reporting quality was acceptable across included full-text publications.

Demographics and clinical features

In all nine included studies, 59 patients underwent POPE for esophageal end-stage achalasia or DGCE after esophagectomy (Table 4). Given the limited methodological detail and outcome reporting in conference abstracts, the primary descriptive analysis focused on the seven full-text studies (four case series and three case reports), comprising 39 patients. This full-text dataset revealed that the mean age was 69.3 ± 8.4 years with a slight predominance of female patients (54%). Most full-text studies were conducted in the USA (86%), whereas one study was reported from Spain (14%).

Within the full-text dataset, POPE was performed for end-stage achalasia in 30 patients (77%) and for DGCE after esophagectomy in nine patients (23%). All patients with esophageal end-stage achalasia had a previous endoscopically or surgically myotomy, whereas patients with DGCE commonly underwent prior pyloric procedures. Table 4 summarizes the main characteristics, outcomes, and adverse events of included studies.

Outcomes (full-text studies)

Table 5 depicts the outcomes evaluated in the primary and secondary analyses (the latter including the conference abstract). Technical success was achieved in 100% of patients, including 30 patients with end-stage achalasia and nine patients with DGCE after esophagectomy. The mean procedure time was 77.3 (range, 57–97) min, requiring between 2 and 11 sutures per session. All patients were discharged either the same day or after short-term observation, which did not exceed 3 days.

Overall symptom improvement was reported in 31 (79.5%) patients, including 25 patients with esophageal end-stage achalasia (83.3%) and six patients with DGCE after esophagectomy (66.7%).

Re-POPE was performed in 12 (30.8%) patients to maintain or restore response (eight patients with esophageal end-stage achalasia and four with DGCE after esophagectomy). When reported, re-POPE was associated with symptomatic improvement.

No intraprocedural adverse events were reported in the analysis, excluding conference abstracts. Postprocedural adverse events occurred in five patients (12.8%) (Tables 4 and 5). No deaths associated with the procedure were reported.

The follow-up time was heterogeneous among the included studies; therefore, a global analysis of the long-term durability of the procedure could not be performed.

Outcomes including conference abstracts

In the overall analysis, including conference abstracts (n = 59), technical success remained 100%. Symptom improvement was reported in 51 patients (86.4%). Re-POPE was performed in 13 patients (22.0%). Intraprocedural and postprocedural adverse events were reported in four (6.8%) and five (8.5%) patients, respectively.

Summary of findings

A summary of findings based exclusively on full-text publications is shown in Table 6. The certainty of evidence was rated as very low for all outcomes because all articles were noncomparative studies (case series and case reports), had small sample sizes, and had heterogeneity in outcome definitions and follow-up.

Discussion

This systematic review summarizes the existing evidence of POPE for patients with end-stage esophageal achalasia (notably, after prior successful treatment at the cardia) or DGCE after esophagectomy. Across nine reports (four series, three case reports, two conference abstracts) encompassing 59 patients, POPE was consistently feasible across published reports, with clinical improvement frequently described in both indications. However, the evidence remains limited to small noncomparative studies.

Clinical relevance, durability, and repeatability

The mechanism by which POPE may improve symptoms in these patients relates to the correction of sump formation, which can generate functional obstruction. Full-thickness sutures in POPE may help straighten the tortuous axis of the esophagus or gastric conduit and reduce the dependent cavity. This remodeling may reduce stasis and potentially improve uniform bolus flow across the esophagogastric junction or pyloric outlet.

In patients with end-stage achalasia, POPE may be an endoscopic option in selected patients who remain symptomatic despite prior therapies; however, its impact on preventing or delaying esophagectomy remains uncertain. Esophagectomy is a major surgery associated with a mean postoperative morbidity and mortality rate of 27.1% and 2.1%, respectively.[22] As previously noted, in patients with achalasia, it should be confirmed, by high-resolution esophageal manometry or Endoflip, that the lower esophageal sphincter is adequately relaxed following prior treatments such as POEM or Heller's myotomy; otherwise, an additional myotomy at the cardia level should be considered first.

In patients with sump formation, assessing clinical response after POPE can be challenging, as validated symptom scores tend to underestimate both symptom burden and improvement. Many patients may continue to experience some degree of dysphagia, yet their overall quality of life markedly improves. However, given the lack of effective alternatives for this group of patients, an acceptable overall clinical response was reported across studies for both indications.

Notably, re-POPE was conducted in a substantial proportion, which may reflect the chronic nature of these conditions. Published cases described re-POPE as a potential strategy to maintain or restore clinical response, although durability and optimal retreatment strategies remain uncertain due to limited follow-up and heterogeneous reporting.

We know from endoscopic sleeve gastrosplasty that approximately 83.6% of sutures persist at 12 months, with 70.9% maintaining adequate tension.[23] We did not evaluate this data with POPE. Some authors have described the combination of mucosal denudation techniques like argon plasma coagulation or endoscopic mucosal resection with POPE, which may potentially enhance submucosa to submucosa apposition, leading to better suture retention and durability,[24,25] but the potential benefits of this modification[18] need further investigation.

Safety profile

Adverse events were infrequently reported and generally managed conservatively or endoscopically, without procedure-related mortality being described. Even in the case of a detectable perforation, further esophageal suturing could repair the defect, as it

has been previously reported.[26] Moreover, in end-stage achalasia, the esophageal wall tends to be thickened and fibrotic due to chronic inflammation and muscular remodeling of the esophageal wall,[27] which may theoretically decrease the risk of transmural perforation during suturing procedures. One patient required subsequent surgery due to delayed perforation from self-expandable metallic stent (SEMS) migration after re-POPE, and one patient required gastrostomy tube placement for gastric obstruction.

Although evidence remains limited, POPE may be considered in highly selected patients with refractory symptoms and suspected sump formation. Candidate selection may include (1) objective confirmation of adequate lower esophageal sphincter relaxation (high-resolution manometry and/or EndoFLIP) in cases of achalasia, (2) treatment history documenting failure of pyloric interventions in DGCE after esophagectomy, and (3) endoscopic and/or imaging evidence of sump formation.

Limitations

This review has several limitations. First, the available evidence is limited to noncomparative studies (series and case reports) with heterogeneous outcome definitions and variable follow-up, which limits the evaluation of durability or the need for re-POPE. Second, conference abstracts were included only when they had all the information necessary for data extraction; however, they frequently lacked sufficient detail for a more thorough analysis. Therefore, the primary analysis was performed using full-text publications, and a secondary analysis included conference abstracts. Finally, patient-level data were not available, precluding subgroup and correlation analyses, and publication bias is likely given the early experience with this emerging technique.

In conclusion, POPE appears feasible and has a reasonable safety profile in published case series and reports and may provide symptomatic benefit in selected patients. However, current evidence is limited and heterogeneous; prospective studies and multicenter registries with standardized outcomes are needed to confirm efficacy and durability.

Acknowledgments:

None.

Author contribution:

Study concept and design: HU and HB. Data acquisition: HU and HB. Data analysis and interpretation: HU and HB. Manuscript drafting and critical revision for important intellectual content: all authors. Statistical analysis: HU and HB. Administrative, technical, or material support and study supervision: all authors.

Conflict of interest

The authors declare no conflicts of interest.

Funding

This study received no external funding.

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TABLES

Table 1 – Search strategies per engine

Pubmed (“Esophagectomy”[Mesh] OR esophagectomy OR esophagectomies OR esophageal surgery OR gastric conduit reconstruction OR neo-esophagus OR “Esophageal Achalasia”[Mesh] OR achalasia OR megaesophagus OR “end-stage achalasia” OR “sigmoid esophagus”) AND (“Gastric Emptying”[Mesh] OR delayed gastric conduit emptying OR DGCE OR gastric stasis OR impaired emptying OR conduit retention OR sump formation) AND (endoscopy OR endoscopic treatment OR endoscopic plication OR peroral plication OR POPE OR endoscopic sleeve gastroplasty OR endoscopic remodeling)
Embase (“esophagectomy”/exp OR esophagectomy OR esophagectom* OR “esophageal resection” OR “esophageal surgery” OR “gastric pull-up” OR “gastric conduit reconstruction” OR neo-esophagus OR “achalasia”/exp OR achalasia OR megaesophagus OR “end-stage achalasia” OR “sigmoid esophagus”)

AND (“gastric emptying delay”/exp OR “delayed gastric emptying” OR “impaired gastric emptying” OR “impaired emptying” OR “gastric conduit emptying” OR “gastric conduit stasis” OR “gastric conduit retention” OR “gastric conduit dysfunction” OR “sump formation” OR “gastric stasis” OR DGCE OR “esophageal stasis” OR “esophageal retention”) AND (“endoscopy”/exp OR endoscopy OR “endoscopic treatment” OR “endoscopic management” OR “peroral plication” OR “peroral plication” OR “endoscopic plication” OR POPE OR “endoscopic sleeve gastroplasty” OR “endoscopic remodeling” OR “endoscopic suturing”)
Scopus TITLE-ABS-KEY (esophagectomy OR esophagectom* OR “esophageal resection” OR “esophageal surgery” OR “gastric pull-up” OR “gastric conduit reconstruction” OR neo-esophagus OR achalasia OR megaesophagus OR “end-stage achalasia” OR “sigmoid esophagus”) AND TITLE-ABS-KEY (“delayed gastric emptying” OR “impaired gastric emptying” OR “impaired emptying” OR “gastric conduit emptying” OR “gastric conduit stasis” OR

“gastric conduit retention” OR “gastric conduit dysfunction” OR “sump formation” OR “gastric stasis” OR DGCE OR “esophageal stasis” OR “esophageal retention”) AND TITLE-ABS-KEY (endoscopy OR “endoscopic treatment” OR “endoscopic management” OR “peroral plication” OR “peroral plication” OR “endoscopic plication” OR POPE OR “endoscopic sleeve gastroplasty” OR “endoscopic remodeling” OR “endoscopic suturing”)
Web of Science TS = (esophagectomy OR esophagectom* OR “esophageal resection” OR “esophageal surgery” OR “gastric pull-up” OR “gastric conduit reconstruction” OR neo-esophagus OR achalasia OR megaesophagus OR “end-stage achalasia” OR “sigmoid esophagus”) AND TS = (“delayed gastric emptying” OR “impaired gastric emptying” OR “impaired emptying” OR “gastric conduit emptying” OR “gastric conduit stasis” OR “gastric conduit retention” OR “gastric conduit dysfunction” OR “sump formation” OR “gastric stasis” OR DGCE OR “esophageal stasis” OR “esophageal retention”) AND TS = (endoscopy OR “endoscopic treatment” OR “endoscopic management” OR “peroral plication” OR “peroral plication” OR “endoscopic plication” OR POPE OR “endoscopic

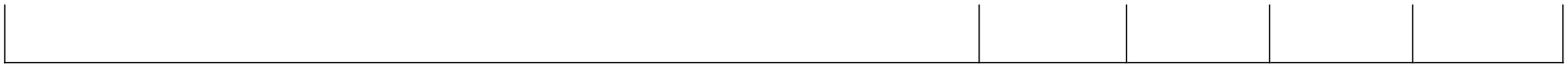
sleeve gastroplasty” OR “endoscopic remodeling” OR “endoscopic suturing”)

TS = (endoscopy OR “endoscopic treatment” OR “endoscopic management” OR “peroral plication” OR “peroral plication” OR “endoscopic plication” OR POPE OR “endoscopic sleeve gastroplasty” OR “endoscopic remodeling” OR “endoscopic suturing”)

Table 2: Quality assessment of case series with Joanna Briggs Institute Critical Appraisal Checklists

Checklist	Hedberg et al, 2023	Crafts et al, 2024	Bateman et al, 2025	Alexander et al, 2025
Were there clear criteria for inclusion in the case series?	Yes	Yes	Yes	Yes
Was the condition measured in a standard, reliable way for all participants included in the case series?	Yes	Yes	Yes	Yes
Were valid methods used for the identification of the condition for all participants included in the case series?	Yes	Yes	Yes	Yes
Did the case series have consecutive inclusion of participants?	Unclear	Yes	Unclear	Unclear
Did the case series have complete inclusion of participants?	Yes	Yes	Yes	Yes
Was there clear reporting of the demographics of the participants in the study?	Yes	Yes	Yes	Yes
Was there clear reporting of clinical information of the participants?	Yes	Yes	Yes	Yes
Were the outcomes or follow-up results of cases clearly reported?	Yes	Yes	Yes	Yes
Was there clear reporting of the presenting site(s)/clinic(s) demographic information	Unclear	Unclear	Unclear	Unclear
Was the statistical analysis appropriate?	Not	Yes	Yes	Yes

	applicable			



	Not applicable			
Overall score	7/9	9/10	8/10	8/10
Risk-of-bias classification	Low–moderate	Low–moderate	Low–moderate	Low–moderate

Table 3: Quality assessment of case reports with Joanna Briggs Institute Critical Appraisal Checklists

Checklist	Bazerbachi et al, 2017	Khan et al, 2024	Uchima et al, 2025
Were the patient's demographic characteristics clearly described?	Yes	Yes	Yes
Was the patient's history clearly described and presented as a timeline?	Yes	Yes	Yes
Was the current clinical condition of the patient on presentation clearly described?	Yes	Yes	Yes
Were diagnostic tests or assessment methods used, and the results clearly described?	Yes	Yes	Yes
Were the intervention(s) or treatment procedure(s) clearly described?	Yes	Yes	Yes
Was the post-intervention clinical condition clearly described?	Yes	Yes	Yes
Were adverse events (harms) or unanticipated events identified and described?	No	No	No

Does the case report provide takeaway lessons?	Yes	Yes	Yes
Overall score	7/8	7/8	7/8
Risk-of-bias classification	Low–moderate	Low–moderate	Low–moderate

Table 4. Main characteristics, outcomes, and adverse events of included studies

Reference	Study type	n	Female/ Male (n)	Age, years	Diagnosis before treatment	Previous treatments	Sutures per session (n)	Procedural time (min)	Technical success n/N (%)	% Clinical response n/N (%)	Intraprocedural adverse events (n)	Postprocedural adverse events (n)	Length of stay (days)	Imaging after procedure	Follow-up	Re-POPE n/N (%)	Eckardt Score prior plication	Eckardt Score post plication
Uchima et al, 2025 (Spain)	Case report	1	1/0	72	DCGE after esophagectomy	Pyloric botulinum toxin injection	4	N. A.	1/1 (100%)	1/1 (100%)	0	0	2	Esophagogram	4 months	0/1 (0%)	N. A.	N. A.
Bateman et al, 2025 (USA)	Case series	6	6/0	N. A.	End-stage achalasia	• 3 Heller myotomy • 2 endoscopes for dilation • 1 peroral endoscopic myotomy	3.33*	97*	6/6 (100%	6/6 (100%)	0	Major: 0 Minor: Postoperative bleeding (managed conservatively) (n = 1)	N. A.	N. A.	<u>Short-term:</u> • 6-12 weeks <u>Long-term:</u> • 6-12 months	0/6 (0%)	6.17*	<u>Short-term:</u> • 1.83* <u>Long-term:</u> • 3.5*
Alexander et al, 2025 (USA)	Case series	12	6/6	66*	End-stage achalasia	• 12 endoscopic dilatations • 2 botulinum toxin injections	4.5*	57*	12/12 (100%)	9/12 (75%)	0	0	0**	Esophagogram	4 years* (including follow-up after re-POPE)	6/12 (50%)	7*	Reduction of 2.5*

						• 1 peroral endoscopic myotomy • 10 surgical myotomy												
Khan et al, 2024 (USA)	Case report	1	0/1	77	DCGE after esophagectomy	Stenting	11	N. A.	1/1 (100%)	1/1 (100%)	0	0	3	Esophagogram	4 months	1/1 (100%)	N. A.	N. A.
Andalib et al, 2024 (USA)	Conference abstract	19	11/8	71*	End-stage achalasia	19 peroral endoscopic myotomy	N. A.	48*	19/19 (100%	19/19 (100%)	Major: • 3 mucosal perforations (resolved with clips) • 1 bleeding (resolved with coagulation) Minor: 0	0	N. A.	N. A.	13.5 months*	0/19 (0)	9.15*	2.2*

Cratfs et al, 2024 (USA)	Case series	13	5/8	65*	• 8 End-stage achalasia • 5 DCGE after esophagectomy	<u>End-stage achalasia:</u> • 3 endoscopic dilatations • 4 Heller myotomy • Other interventions (botulinum toxin injection, stenting, and a transthoracic myotomy) <u>DCGE after esophagectomy:</u> • 3 pyloromyotomy • 2 pyloroplasty	3*	75*	13/13 (100%)	<u>End-stage achalasia:</u> • 6/8 (75%) <u>DCGE after esophagectomy:</u> • 3/5 (60%)	0	<u>End-stage achalasia:</u> Major: 0 Minor: • 1 case of pain (managed conservatively) <u>DCGE after esophagectomy:</u> Major: • 2 aspiration pneumonia (required antibiotics) • 1 delayed perforation due to SEMS migration after re-POPE (required surgery)	0.25*	<u>End-stage achalasia:</u> • 2 esophagograms <u>DCGE after esophagectomy:</u> • 1 gastric emptying	20 weeks**	<u>End-stage achalasia:</u> • 2/8 (25%) <u>DCGE after esophagectomy:</u> • 2/5 (40%)	3.4* (11 patients)	<u>3 weeks:</u> • 2.6* (5 patients) <u>6 months:</u> • 2.2* (5 patients) <u>1 year:</u> • 5.5* (3 patients)

												• 1 gastric obstruction that required gastrostomy tube placement Minor: 0						
Wieland et al, 2024 (USA)	Conference abstract	1	0/1	76	DCGE after esophagectomy	Pyloroplasty (during esophagectomy) + Pyloric botulinum toxin injection + Pyloric endoscopic dilation	N. A.	N. A.	1/1 (100%)	1/1 (100%)	N. A.	N. A.	N. A.	N. A.	5 years	1/1 (100%)	N. A.	N. A.
Hedberg et al, 2023 (USA)	Case series	5	2/3	57*	• 3 End-stage achalasia • 2 DCGE after esophagectomy	<u>End-stage achalasia:</u> • 2 Heller myotomy • 1 thoracic myotomy <u>DCGE after esophagectomy:</u> • 2	3.2*	80*	5/5 (100%)	<u>End-stage achalasia:</u> • 3/3 (100%) <u>DCGE after esophagectomy:</u> • 1/2 (50%)	0	0	1**	N. A.	N. A.	1/5 (20)	N. A.	N. A.

						pyloromyotomy												
Bazerbachi et a, 2017 (USA)	Case report	1	1/0	79	End-stage achalasia	Surgical myotomy	5	N. A.	1/1 (100%)	1/1 (100%)	0	0	N. A.	Esophagogram	6 months	0/1 (0%)	N. A.	N. A.

Abbreviations:

POPE: Peroral plication of the esophagus

DGCE: Delayed gastric conduit emptying

SEMS: self-expandable metallic stent

NA.: Not available

*: Mean

**: Median

Table 5: Demographic data, clinical outcomes, and adverse events

	Analysis including conference abstracts = 59 patients		Analysis excluding conference abstracts = 39 patients	
Age, mean ± SD (years)	70.4 ± 7.2	%	69.3 ± 8.4	%
Country of study				
USA, n/N	8/9	88.89	6/7	85.71
Spain, n/N	1/9	11.11	1/7	14.29
Gender				
Male, n/N	27/59	45.76	18/39	46.15
Female, n/N	32/59	54.24	21/39	53.85
Diagnosis before treatment				
End-stage achalasia, n/N	49/59	83.05	30/39	76.92
DGCE after esophagectomy, n/N	10/59	16.95	9/39	23.08
Techincal success	59/59	100.00	39/39	100/100
End-stage achalasia, n/N	49/49	100.00	30/30	100.00

DGCE after esophagectomy, n/N	10/10	100.00	9/9	100.00
Mean procedure time, mean (range), min	71.4 (range, 48–97)		77.3 (range, 57–97)	
Symptoms improvement	51/59	86.44	31/39	79.49
End-stage achalasia, n/N	44/49	89.80	25/30	83.33
DGCE after esophagectomy, n/N	7/10	70.00	6/9	66.67
Adverse events				
Intraprocedural adverse events, n/N	4/59	6.78	0/39	0.00
Mucosal perforation, n/N	3/59	5.08	0/39	0.00
Bleeding, n/N	1/59	1.69	0/39	0.00
Postprocedural adverse events, n/N	5/59	8.47	5/39	12.82
Bleeding, n/N	1/59	1.69	1/39	2.56
Pain, n/N	1/59	1.69	1/39	2.56
Aspiration pneumonia,	2/59	3.39	2/39	5.13

n/N

Aspiration pneumonia, n/N				
Gastric obstruction that required gastrostomy tube placement, n/N	1/59	1.69	1/39	2.56
Re-POPE, n/N	13/59	22.03	12/39	30.77

Abbreviations:

USA: United States of America

DGCE: Delayed gastric conduit emptying

POPE: Peroral plication of the esophagus

Conference abstracts excluded: Andalib et al. 2024; Wieland et al. 2024.

Table 6: Summary of findings by each outcome

Outcome	Effect	Number of participants (studies)	Certainty in evidence*
Technical success	All full-text publications reported successful completion of POPE (high feasibility).	39 (7)	VERY LOW ⨁◯◯◯†
Clinical response	Most studies demonstrated symptomatic improvement after POPE; response definitions and follow-up varied.	39 (7)	VERY LOW ⨁◯◯◯†
Need for repeat POPE (re-POPE)	Repeat POPE was required in a subset of patients, suggesting limited durability in some cases and/or need for retreatment.	39 (7)	VERY LOW ⨁◯◯◯†

Adverse events	Adverse events were infrequently reported and mostly managed conservatively/endoscopically.	39 (7)	VERY LOW ⨁◯◯◯†

*Certainty categories: high ⨁⨁⨁⨁, moderate ⨁⨁⨁◯, low ⨁⨁◯◯, very low ⨁◯◯◯.

†Reasons for very low certainty: The evidence base consisted exclusively of non-comparative designs (case series and case reports). Although methodological quality was overall acceptable based on JBI critical appraisal, certainty was limited by the following:

(1) Risk-of-bias inherent to uncontrolled designs and incomplete reporting

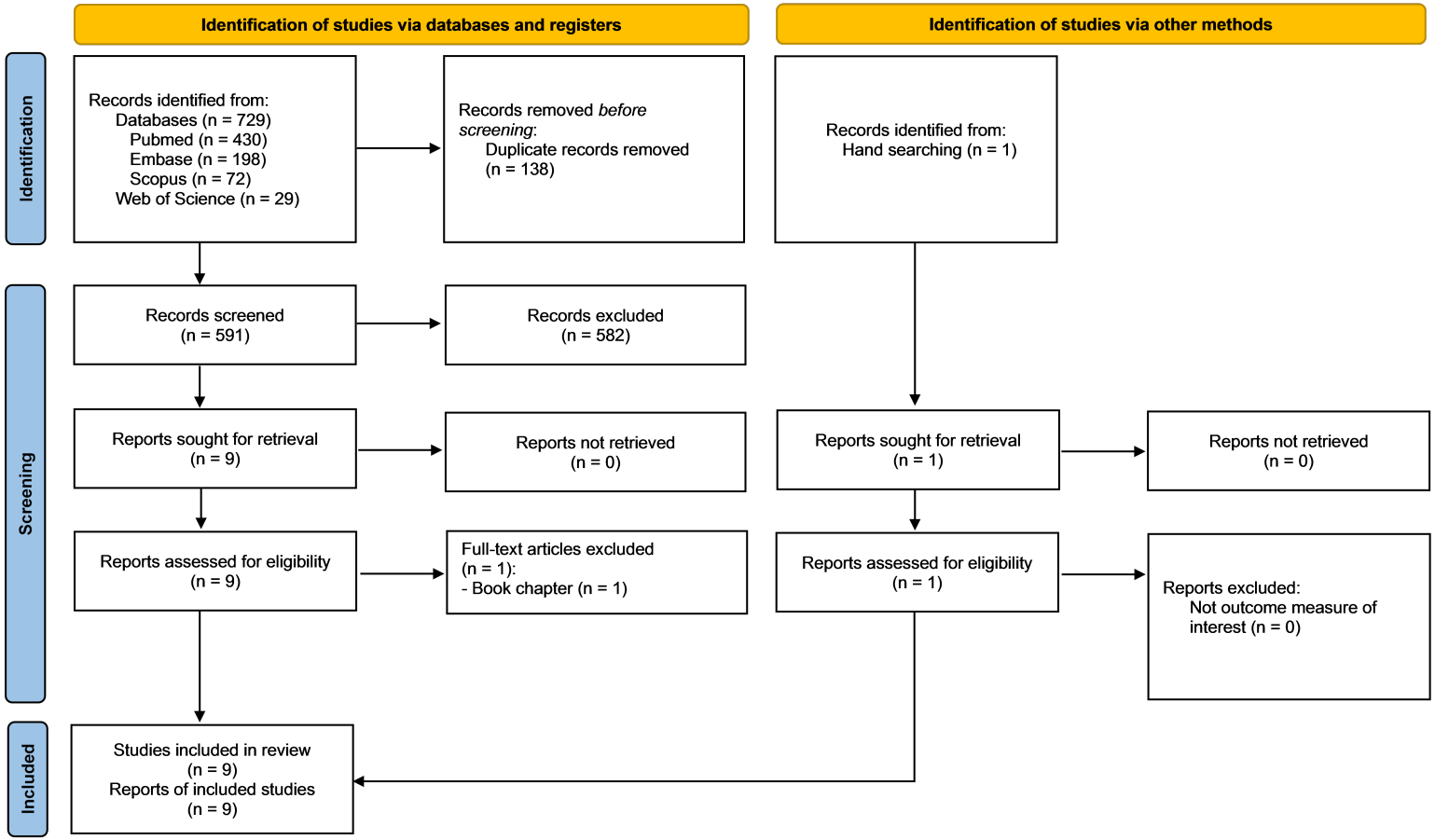
(2) Imprecision due to small sample sizes and few events

(3) Inconsistency in outcome definitions (particularly clinical response) and variable follow-up

(4) Indirectness due to mixed indications (end-stage achalasia vs. DGCE after esophagectomy) and heterogeneity in previous interventions

(5) Publication bias that likely occurs during the early experiences of novel endoscopic techniques

Figure 1. Flow diagram of study selection.



The only full-text record was excluded because it was not an original peer-reviewed article (book chapter).