World Journal of Emergency Surgery

REVIEW

Open Access

Acute paraesophageal hernia with gastric volvulus. Results of surgical treatment: a systematic review and meta-analysis

Carlos Manterola[1,2*], Enrique Biel[3,4,5*], Josue Rivadeneira[2,6*], Manuel Pera[4,5,7,8] and Luis Grande[4,7,8]

Abstract

Introduction Acute gastric volvulus (AGV), is an uncommon complication of large paraesophageal hernias (PEH), resulting in closed-loop obstruction that may lead to incarceration and strangulation. The aim of this study was to summarize the evidence on clinical characteristics, surgical treatment, postoperative complications (POC), recurrence, and 30-day mortality (30DM), in patients undergoing surgery for AGV secondary to PEH.

Methods A systematic review including studies on AGV secondary to PEH was conducted. Searches were performed in WoS, Embase, Medline, Scopus, BIREME-BV and SciELO. Primary outcomes included POC, 30DM and recurrence. Secondary outcomes comprised publication date, study origin and design, number of patients, volvulus type, hospital stay length, treatments; and methodological quality (MQ) of studies assessed using MInCir-T and MInCir-Pr_2 scales. Descriptive statistics, weighted averages (WA), least squares logistic regression for comparisons, and meta-analysis of POC prevalence and HM were applied.

Results Of 1049 studies 171 met selection criteria, encompassing 15,178 patients. The WA age of patients was 75.3 ± 13.9 years, with 51.3% female. Most studies originated from USA (31.6%), with 52.6% published in the last decade. The WA of hospital stay was 7.9 ± 5.3 days. Among patients, 32.0% experienced POC, 7.6% required reinterventions and HM was 5.7%. MQ scores averaged 8.9 ± 2.3 (MInCir-T) and 13.4 ± 5.4 (MInCir-Pr_2). When comparing 1990–2014 and 2015–2024 periods, there were significant differences in age, reinterventions, readmissions and recurrence rates.

Conclusions Despite surgical and resuscitative advancements, AGV prognosis remains poor, with high POC rates, prolonged hospitalization and significant 30DM. These findings emphasize the importance of early diagnosis and timely intervention for acute PEH to improve surgical outcomes.

Carlos Manterola and Enrique Biel shares first authorship.

*Correspondence:
Carlos Manterola
carlos.manterola@ufrontera.cl
Enrique Biel
ebielw@gmail.com
Josue Rivadeneira
md.josue.rivadeneira@gmail.com

Full list of author information is available at the end of the article

Keywords Stomach Volvulus [Mesh], Gastric volvulus, Hiatal hernia [Mesh], Systematic review, Postoperative Complications [Mesh], Hospital Mortality [Mesh]

Background

Acute gastric volvulus (AGV) can occur secondary to a paraesophageal hernia (PEH). Although AGV/PEH combination is a rare, it represents a serious clinical condition with poorly defined incidence and risk factors. Approximately 1% of patients with PEH present acute symptoms and require emergency surgery annually [1, 2]. While its incidence and prevalence remain unclear, AGV is more frequently observed from the fifth decade of life [2]. Typically associated with Borchardt's triad–vomiting, epigastric pain, and inability to pass a nasogastric tube – this classical presentation is reported in fewer than 70% of cases [3].

Markar et al., analyzed data from 12,441 patients with acute PEH in the English Hospital Episode Statistics (HES database (1977–2012) [3]. Their study revealed 30- and 90-day mortality rates of 7.0% and 11.5%, respectively. Interestingly, after propensity-matching, demonstrated that high-volume centers significantly reduced emergency surgery when compared with medium and low-volume, and that low and medium hospital volume was independently associated with increased 30-day and 90-day mortality for acute PEH [3].

Similarly, a cohort study from the US General Thoracic Surgery Database comprising 2,082 patients emergently or urgently operated for PEH, reported high operative times, longer hospital stays, higher intraoperative blood transfusions and greater morbidity and mortality compared to elective PEH [4]. Additionally, it has been observed that patients over 80 years old undergoing emergent operations exhibited the highest morbidity and mortality rates, reflecting disease severity and comorbidities [4, 5].

Regarding surgical approach and techniques, literature supports the safety of fundoplication in acute PEH [6] and reports laparoscopic techniques successful in over 70% of urgent cases, despite open repair being more common, compared to elective cases [7, 8].

Although evidence exists regarding the management of acute diaphragmatic hernias [9]—which can include paraesophageal hernias (PEH) among other causes—no prior systematic reviews have specifically focused on the management of AGV/PEH in adults. As a result, key questions remain unresolved, including the optimal timing of intervention, choice of surgical techniques, and preferred operative approaches. Given these uncertainties, evaluating surgical outcomes is essential to inform and tailor treatment strategies to individual patients [9].

The study aims to review evidence on clinical characteristics, surgical treatment, POC and 30DM, observed in patients undergoing surgery for AGV/PEH.

Methods

This manuscript has been prepared in accordance with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines [10] and the AMSTAR (Assessing the methodological quality of systematic reviews) standards [11].

Study protocol Registered in PROSPERO (International prospective register of systematic reviews, NIHR), ID: CRD42024620580.

Study design Systematic review (SR).

Eligibility criteria All types of primary studies (experimental and observational) reporting POC and 30DM of patients treated for AGV/PEH, diagnosed by radiology, computed tomography, or magnetic resonance imaging, published between 1990 and 2024 were included. No language or geographic restrictions were applied to the selection of manuscripts. Editorials, letters to the editor, narrative reviews, consensus documents and discussions were excluded. Additionally, articles involving patients treated for uncomplicated diaphragmatic hernias, regardless of their size and etiology, chronic gastric volvulus, or gastric volvulus following surgery for PEH or gastroesophageal reflux disease, or other thoracic or abdominal conditions, were also excluded.

Information sources The following metasearch engines, libraries, and databases were reviewed: Web of Sciences (WoS), Embase, Medline, Scopus, BIREME-BV and SciELO. The search and recruitment of articles closed on December 30, 2024. Manual searches of cross-referenced articles and grey literature were conducted.

Search strategies This was carried out using the PECO components (population study [P: patients with AGV], exposure [E: Surgery], comparator [C: none], and result [O: POC and 30DM]). Sensitive searches were conducted by adapting the search strategy for each information source, considering the use of MeSH, DeCS, and Emtree terms, as well as free terms incorporated using Boolean operators (Table 1). A manual and cross-reference search was also carried out.

Regarding the selection of MeSH terms from the National Library of Medicine, given the absence of

Table 1 Search strategies and results obtained for each information source(*N* = 1,049)

Sources	Search strategies
PubMed (*n* = 183)	("hernia, hiatal"[MeSH Terms] OR "hernia hiatal"[Title/Abstract] OR "hernias hiatal"[Title/Abstract] OR "hiatal hernia*"[Title/Abstract] OR "hernia* hiatus"[Title/Abstract] OR "hiatus hernia*"[Title/Abstract] OR "esophageal hernia*"[Title/Abstract] OR "esophagus hiatus"[Title/Abstract] OR "esophageal hiatal hernia"[Title/Abstract] OR "esophageal hiatus"[Title/Abstract] OR "esophagus hernia"[Title/Abstract] OR "paraesophageal hernia*"[Title/Abstract]) AND ("Stomach Volvulus"[MeSH Terms] OR "Stomach Volvulus"[Title/Abstract] OR "Gastric Volvulus"[Title/Abstract] OR "gastric torsion"[Title/Abstract] OR "volvulus stomach"[Title/Abstract] OR "stomach torsion"[Title/Abstract] OR "Acute gastric volvulus"[Title/Abstract]) AND ("surgical procedures, operative"[MeSH Terms] OR "surgical procedure*"[Title/Abstract] OR "procedure* surgical"[Title/Abstract] OR "operative procedure*"[Title/Abstract] OR "procedure* operative"[Title/Abstract] OR "surgery operative"[Title/Abstract] OR "techniques surgical"[Title/Abstract] OR "operation*"[Title/Abstract] OR "repair operative"[Title/Abstract] OR "surgery resection"[Title/Abstract] OR "intervention surgical"[Title/Abstract] OR "management surgical"[Title/Abstract] OR "repair surgical"[Title/Abstract] OR "therapy surgical"[Title/Abstract] OR "treatment surgery"[Title/Abstract])
Scopus (*n* = 110)	TITLE-ABS-KEY ((("hiatus hernia" OR "hernia, hiatal" OR "hernia, hiatus" OR "hiatal hernia" OR "esophagus hiatus" OR "esophageal hiatal hernia" OR "esophageal hiatus" OR "esophagus hernia" OR "hiatus oesophagus hernia" OR "paraesophageal hernia") AND ("stomach volvulus" OR "gastric torsion" OR "gastric volvulus" OR "stomach torsion" OR "stomach volvulus" OR "acute gastric volvulus")) AND ("surgical procedures, operative" OR "surgical procedure*" OR "procedure* surgical" OR "operative procedure*" OR "procedures operative" OR "surgery operative" OR "techniques, surgical" OR "operation*" OR "intervention operative" OR "repair operative" OR "surgery resection" OR "correction surgical" OR "surgery, operative" OR "intervention surgical" OR "management surgical" OR "repair surgical" OR "restoration surgical" OR "therapy surgical" OR "treatment surgery"))
EMBASE (*n* = 514)	('hiatus hernia'/exp OR 'hiatus hernia':ti, ab OR 'hernia, hiatal':ti, ab OR 'diaphragmatic hernia, esophagus hiatus':ti, ab OR 'esophageal hiatal hernia':ti, ab OR 'esophageal hiatus':ti, ab OR 'esophagus hernia':ti, ab OR 'esophagus hiatus hernia':ti, ab OR 'hiatal esophageal hernia':ti, ab OR 'hernia, hiatus':ti, ab OR 'hiatal hernia':ti, ab OR 'hiatal herniation':ti, ab OR 'hiatus herniation':ti, ab OR 'hiatus oesophagus hernia':ti, ab OR 'oesophageal hiatal hernia':ti, ab OR 'para-esophageal hernia':ti, ab OR 'para-esophageal herniation':ti, ab OR 'paraesophageal hernia':ti, ab OR 'paraoesophageal hernia':ti, ab) AND ('stomach volvulus'/exp OR 'gastric torsion':ti, ab OR 'gastric volvulus':ti, ab OR 'stomach torsion':ti, ab OR 'stomach volvulus':ti, ab OR 'acute gastric volvulus':ti, ab) AND ('surgery'/exp OR 'techniques, surgical':ti, ab OR 'operation':ti, ab OR 'intervention operative':ti, ab OR 'repair operative':ti, ab OR 'surgery resection':ti, ab OR 'correction surgical':ti, ab OR 'resective surgery':ti, ab OR 'surgery, operative':ti, ab OR 'intervention surgical':ti, ab OR 'management surgical':ti, ab OR 'repair surgical':ti, ab OR 'restoration surgical':ti, ab OR 'therapy surgical':ti, ab OR 'treatment surgery':ti, ab)
WoS (*n* = 83)	TS=((("hernia* hiatal" OR "hiatal hernia*" OR "hernia* hiatus" OR "hiatus hernia*" OR "esophageal hernia*" OR "esophagus hiatus" OR "esophageal hiatus" OR "paraesophageal hernia*") AND ("Stomach Volvulus" OR "Gastric Volvulus" OR "gastric torsion" OR "volvulus stomach" OR "stomach torsion" OR "Acute gastric volvulus")) AND ("surgical procedures, operative" OR "surgical procedure*" OR "procedure* surgical" OR "operative procedure*" OR "procedure* operative" OR "surgery operative" OR "techniques surgical" OR "operation*" OR "repair operative" OR "surgery resection" OR "intervention surgical" OR "management surgical" OR "repair surgical" OR "therapy surgical" OR "treatment surgery"))
BVS-BIREME (*n* = 157)	Titulo, Resumen, Palabras Clave: (("hernia, hiatal" OR "hernias hiatal" OR "hiatal hernia*" OR "hernia*, hiatus" OR "hiatus hernia" OR "Hérnia Hiatal" OR "Hernia de Hiato" OR "Hernia Esofágica" OR "Hernia Hiatal" OR "esophagus hiatus" OR "esophageal hiatus" OR "esophageal hernia*" OR "paraesophageal hernia*" OR "Hernia Paraesofágica") AND ("Stomach Volvulus" OR "gastric torsion" OR "gastric volvulus" OR "stomach torsion" OR "stomach volvulus" OR "acute gastric volvulus" OR "Vólvulo Gástrico" OR "Vólvulo del Estómago" OR "Volvo Gástrico")) AND ("surgical procedures, operative" OR "surgical procedure*" OR "procedure* surgical" OR "operative procedure*" OR "procedure* operative" OR "surgery operative" OR "techniques, surgical" OR "operation*" OR "intervention operative" OR "repair operative" OR "surgery resection" OR "correction surgical" OR "surgery, operative" OR "intervention surgical" OR "management surgical" OR "repair surgical" OR "restoration surgical" OR "therapy surgical" OR "treatment surgery" OR "Procedimientos Quirúrgicos Operativos" OR "Intervención Quirúrgica" OR "Intervenciones Quirúrgicas" OR "Operación Quirúrgica" OR "Operaciones Quirúrgicas" OR "Procedimientos Quirúrgicos" OR "Procedimentos Cirúrgicos Operatórios" OR "Intervenção Cirúrgica" OR "Intervenções Cirúrgicas" OR "Operação Cirúrgica" OR "Operações Cirúrgicas" OR "Procedimentos Cirúrgicos")
SciELO (*n* = 2)	(("hernia, hiatal" OR "hernias hiatal" OR "hiatal hernia*" OR "hernia*, hiatus" OR "hiatus hernia" OR "Hérnia Hiatal" OR "Hernia de Hiato" OR "Hernia Esofágica" OR "Hernia Hiatal" OR "esophagus hiatus" OR "esophageal hiatus" OR "esophageal hernia*" OR "paraesophageal hernia*" OR "Hernia Paraesofágica") AND ("Stomach Volvulus" OR "gastric torsion" OR "gastric volvulus" OR "stomach torsion" OR "stomach volvulus" OR "acute gastric volvulus" OR "Vólvulo Gástrico" OR "Vólvulo del Estómago" OR "Volvo Gástrico")) AND ("surgical procedures, operative" OR "surgical procedure*" OR "procedure* surgical" OR "operative procedure*" OR "procedure* operative" OR "surgery operative" OR "techniques, surgical" OR "operation*" OR "intervention operative" OR "repair operative" OR "surgery resection" OR "correction surgical" OR "surgery, operative" OR "intervention surgical" OR "management surgical" OR "repair surgical" OR "restoration surgical" OR "therapy surgical" OR "treatment surgery" OR "Procedimientos Quirúrgicos Operativos" OR "Intervención Quirúrgica" OR "Intervenciones Quirúrgicas" OR "Operación Quirúrgica" OR "Operaciones Quirúrgicas" OR "Procedimientos Quirúrgicos" OR "Procedimentos Cirúrgicos Operatórios" OR "Intervenção Cirúrgica" OR "Intervenções Cirúrgicas" OR "Operação Cirúrgica" OR "Operações Cirúrgicas" OR "Procedimentos Cirúrgicos")

concepts for acute paraesophageal hernia (PEH) and acute gastric volvulus (AGV), the following terms were chosen: **"Stomach Volvulus"** (ID: D013277), defined as the twisting of the stomach, which may lead to gastric ischemia and gastric outlet obstruction (often associated with diaphragmatic hernia) and encompasses the concept of gastric volvulus; **"Gastric Volvulus, Intrathoracic"** (ID: C564989), classified as a supplementary concept; and **"Hernia, Hiatal"** (ID: D006551), which includes paraesophageal hernia.

Selection process Identified documents from each information source were managed using COVIDENCE® software with duplicates removed both automatically and manually. Subsequently they were screened by title and abstract by four authors (CM, EB, JR, MP), using the eligibility criteria. Then, full-text reports of potentially eligible studies were retrieved and independently assessed by the same four authors, all of whom have extensive experience in searching and analyzing biomedical studies. Discrepancies at any stage were resolved by consensus; if necessary, a fifth reviewer (LG) was consulted to reach a decision.

Data collection The data extraction process was conducted independently by at least two reviewers, using a previously validated and standardized form developed based on the CHARMS-PF tool. Any inconsistencies were resolved by consensus among the reviewers. Then, data was collected in an Excel spreadsheet using a validated matrix [12, 13].

Data items and outcomes Primary outcome variables were POC and 30DM. POC were defined as any pathologic processes that affect patients after surgery in patients with AGV due to PEH. POC may or may not be related to the underlying disease or the surgery itself. POC were assessed dichotomously (present or absent) and graded using the Clavien-Dindo classification [14]. Thirty-day mortality was defined as the rate of death from any cause within 30 days after surgery for AGV and was measured dichotomously (alive or not). Secondary outcome variables included the year of publication of primary articles (reported as in percentages), geographical origin of the studies, study designs and level of evidence based on Centre for Evidence-Based Medicine [15], the number of cases considered in each study, main clinical manifestation (reported as in percentages), type of volvulus, surgical procedure performed, other associated therapeutics interventions (reported in percentages), length of hospital stay (in days) and need for reoperations.

Study risk of bias MQ of primary studies was determined applying MInCir scales for therapeutic procedures (MInCir-T) and prognosis (MInCir-Pr_2) [16, 17]. Both used scales are valid (demonstrating face and content validity, and construct validity for extreme groups) and reliable (interobserver reliability). MInCir-T scale comprises 3 domains and 6 items: the first related to the study design; the second to the population sample size, and the third to the used methodology. A score is generated by summing the 3 domains yield a total score ranging from 6 to 36 points (6 points represent the lowest MQ study and 36 the highest). A score of 18 serves as the cut-off point to define acceptable MQ [16]. The MInCir-Pr_2 scale includes 4 domains and 11 items, covering study design, population sample size, methodology, analysis and conclusions. The sum of these 4 domains generates a score ranging from 7 to 60 points (7 being the lowest MQ study and 60 the highest), with a cut-off of 33 to define acceptable MQ [17]. Both scores were applied to each article by a pair of investigators, who resolved any discrepancies by consensus. Data were then entered into a spreadsheet, and weighted averages (WA) were calculated. A weighted least squares regression model was applied to compared results, using the number of patients of each scientific article as the weighting factor.

Statistics Descriptive statics were applied, including the calculation of percentages, averages and WA. A meta-analysis was performed to compare the behavior of the study variables across two time periods (1990–2015, period A vs. 2016–2024, period B), aiming to verify whether significant differences in the variables under study emerged over time. The cutoff point was established based on the 50th percentile of the number of studies (52% vs. 48%) and a proportionally balanced distribution of patients (41% vs. 59%), respectively. This analysis utilized a weighted least squares regression model, where weights were based on the number of patients of each scientific article. The time periods were dichotomized based on an exploratory data analysis, which verified that this division provided a balance sample.

Additional analyses In addition, meta-analyses of proportions were performed for POC and 30DM, in those primary articles with at least 10 subjects. A random-effects model was employed using the Hartung-Knapp-adjusted inverse variance method and proportions were transformed using the Freeman-Tukey method. Heterogeneity was assessed using I^2 statistics and subgroup analyses were conducted to evaluate the causes of methodological heterogeneity considering the research design. Comparison between fixed- and random-effects meta-analyses were also made. Publication bias was assessed qualitatively and by Funnel Plot. All analyses were conducted using the R Studio Version 4.4.2.

The behavior of the study variables was determined using the WA of each variable. The WA was calculated as the sum of the product of the study variable by the sample size of where the article came from, divided by the sum of methodological quality scores of all the study articles. The following formula was applied ($\boldsymbol{WA} = \boldsymbol{\Sigma Xi * ei} / \boldsymbol{\Sigma ei}$), in which WA is weighted average; Xi, the value achieved for the outcome in the study "I" (for all outcomes); "ei", represents the sample size of the study I; and "Σei", correspond to the sum of the scores obtained in all the studies [16, 17].

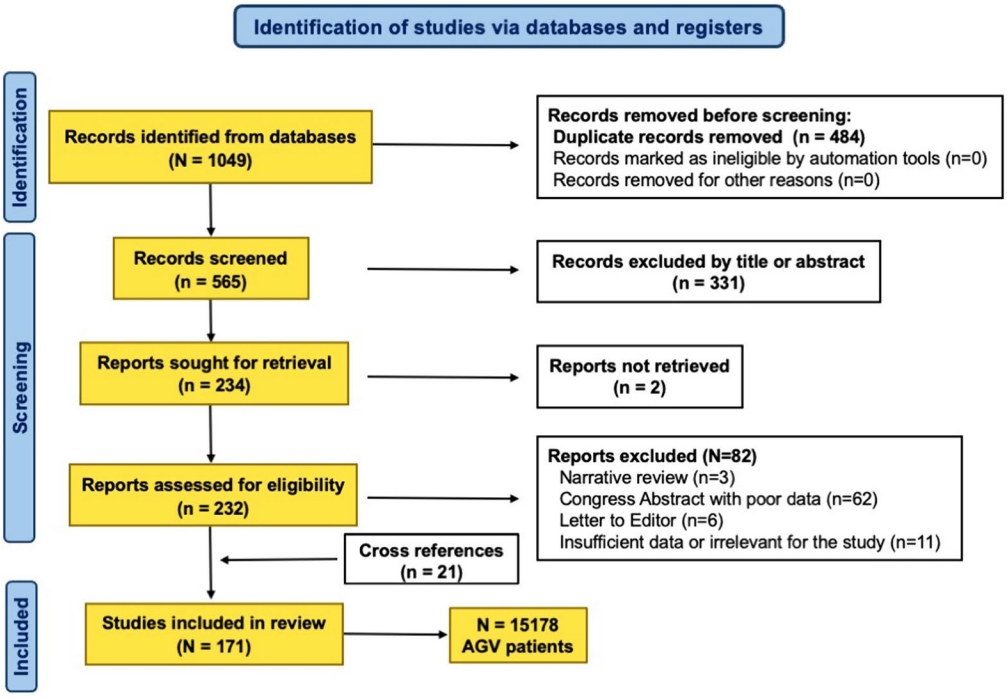

Fig. 1 Flow chart of the analyzed studies

Ethics To reduce possible biases in the selection and analysis, masking of authors and study centers were implemented, coding and masking the primary articles, and deleting the names of authors and centers. Human Ethics and Consent to Participate declarations: not applicable.

Results

Study selection A total of 1,049 studies were identified. Of these, 484 were excluded due to duplication of information sources. The remaining 565 articles underwent title and abstract screening, leading the exclusion of 330 unrelated articles. Of the 235 articles reviewed in full, 4 could not be retrieved and 81 were excluded based on eligibility criteria. In addition, 21 studies were identified through cross referencing, resulting in 171 studies included in the final analysis [18–188] (Fig. 1).

Study characteristics The selected studies included 141 cases reports (82.5%), 18 retrospective case series (10.5%), and 12 observational studies (7.0%), consisting of 7 retrospective cohorts, 2 propensity score analyses, 2 population surveys, and 1 case control study. These studies encompassed 15,178 patients, with a WA age of 75.3 ± 13.9 years, and 51.3% were female. The primary studies provide levels of evidence for treatment studies of 3b (2.9%) and 4 (97.1%), while levels of evidence for prognosis studies were 2b (7.1%) and 4 (92.9%).

Table 2 Year of publication of the included studies (*N* = 171)

Period (years)	Nº of studies	%
2020–2024	46	26.9
2015–2019	44	25.7
2010–2014	43	25.2
2005–2009	18	10.5
2000–2004	7	4.1
1995–1999	7	4.1
1990–1994	6	3.5
Total	**171**	**100**

Synthesis of results Over half (52.6% were published in the last decade (Table 2). Just over 50% of the publications come from four countries, of which the United States is the largest producer (54 studies, 31.6%; Table 3).

The clinical and demographic characteristics and outcomes of the patients included in the review are detailed in Tables 4 and 5. In summary, it is noteworthy that WA of intrathoracic stomach volume was 84.1% and the majority of PEH and AGV were classified as type III PEH (222 cases, 31.6%) and organo-axial (202 cases, 73.9%). In addition, most cases were operated on emergency basis and the open approach was the most used (9934 cases, 86.2%). The most frequent techniques were Nissen fundoplication (39.1%) and gastropexy (23.9%). Table 4 highlights differences between study periods. Notable findings from the more recent period include a significantly older population ($p = 0.011$), a substantial reduction in emergency surgery indications ($p = 0.003$; OR: 1.7

Table 3 Origin of included studies (*N* = 171)

Origin	Nº of studies	%
USA	54	31.6
Japan	16	9.4
Spain	10	5.8
UK	10	5.8
Italy	7	4.1
Taiwan	7	4.1
France	6	3.5
Australia	4	2.3
Brazil	4	2.3
Canada	4	2.3
India	4	2.3
Turkey	4	2.3
Belgium	3	1.8
China	3	1.8
Germany	3	1.8
Others *	16	9.4
Others **	16	9.4
Total	**171**	**100**

*: Greece, Iran, Jordan, Kuwait, Pakistan, Poland, Scotland, and Tunisia (two articles each)

**: Austria, Czech Republic, Colombia, Cuba, Hong Kong, Netherlands, Malaysia, Mexico, Morocco, Nepal, Norway, Portugal, Romania, Singapore, Sri Lanka, and Switzerland (one article each)

[95% CI: 1.2–2.5]), and a decline in the use of the laparoscopic approach ($p < 0.001$; OR: 2.4 [95% CI: 2.1–2.7]). Additionally, there was an increase in reinterventions ($p = 0.035$), along with a marked reduction in readmission and recurrence rates ($p = 0.0001$ and $p < 0.008$ respectively).

The WA of surgical time was 165 ± 67 min. Finally, the WA of time follow-up was 15.7 ± 10.7 months, with 11% of readmissions rate and a 22.2% of recurrence. The WA of POC occurrence was 32.0% with a mortality rate of 5.7%. The most frequent POC were deep vein thrombosis, myocardial infarction, pulmonary thromboembolism and stroke) account for more than 80% of reported events (Table 6).

The meta-analysis identified a POC rate of 0.30 (95% CI: 0.23–0.37) and a 30DM rate of 0.03 (95% CI: 0.02–0.05). In both cases, high heterogeneity was observed, with I^2 values of 94% and 93%, respectively (Figs. 2 and 3).

MQ of primary studies assessed using MInCir-Therapy scale, had a WA score of 8.9 ± 2.3, with only 4 articles scoring exceeding the cutoff. Using the MInCir-Pr_2 scale, the MQ was 13.4 ± 5.4, with 6 studies exceeding the cutoff. This indicates a high likelihood of inaccuracy in causal effect estimates. No statistical differences in MQ were observed between the pre-2015 and post-2015 periods (Table 5).

Finally, statistically significant improvements were observed post-2015 in patient age and reinterventions, while readmission and recurrence rates worsened.

Table 4 Clinical characteristics and outcomes of the patients

Variables	No. cases	%
Reported symptoms (*n* = 157 articles; 654 cases) *, **		
Epigastric pain	465	71.1
Nausea	329	50.3
Vomits	387	58.7
Chest pain	122	18.7
Hematemesis	86	13.1
Borchardt triad	112	17.1
Type of volvulus (*n* = 165 articles; 1,107 cases) *, ***		
Organo-axial	202	18.3
Mesentero-axial	71	(73.9)
Not reported	834	6.4
		(26.1)
		75.3
Type of PEH (*n* = 142 articles; 702 patients) *, ***		
II	14	2.0
III	222	31.6
IV	110	15.7
Not reported	356	50.7
Time of the surgery after admission (*n* = 141 articles; 532 patients)		
Urgent (within the first 24 h)	325	61.1
Up to 7 days	115	21.6
8 to 14 days	18	3.4
15 to 30 days	11	2.1
After 30 days (deferred, elective)	63	11.8
Surgical approach (*n* = 164 articles; 11,518 cases) *,		
Open	9,934	86.2
Laparoscopic	1,463	12.7
Conversion to open surgery	41	0.4
Other options (thoracic and robotic approach)	37	0.3
Not surgical treatment	43	0.4
AGV treatment (*n* = 154 articles; 2,011 cases) *, **		
Nissen fundoplication	787	39.1
Gastropexy	480	23.9
Toupet fundoplication	191	9.5
Use of mesh	165	8.2
Total or partial gastric resection	146	7.3
Gastrostomy	127	6.3
Collis operation	84	4.2
Dor fundoplication	31	1.5
POC - Clavien & Dindo (*n* = 70 articles; 1,989 POC in 9,010 patients) *, #		
Grade II	82	4.1
Grade IIIa	520	26.1
Grade IIIb	632	31.8
Grade IVa	408	20.5
Grade IVb	153	7.7
Grade V	20	1.0
NR	174	8.8

*: The values represent the number of studies in which the variable was reported

**: In some cases, more than one was reported

***: The proportion of presentation among reported cases is shown in parentheses

#: Other options of treatment: Thoracotomy approach (10 cases) and robotic surgery (two cases)

##: Some patients developed more than one POC

NR: Not reported

Table 5 Clinical characteristics and outcomes of patients and studies in the two different time periods

Variables (Weighted average)	TOTAL (Nº studies = 171) (Nº cases = 15,178)	1990–2015 (Nº studies = 89) (Nº cases = 6,260)	2016–2024 (Nº studies = 82) (Nº cases = 8,918)	*p* *
Age (years)	75.3 ± 13.9	70.2 ± 12.3	77.7 ± 13.6	**0.0115**
BMI (Kg/m^2)	26.9 ± 3.1	26.6 ± 4.2	27.3 ± 2.2	0.4673
Total leukocytes (10e^3/uL)	15,056 ± 6,008	17,291 ± 6,464	17,417 ± 5,397	0.9433
Creatinine (mg/dL)	2.1 ± 1.2	2.8 ± 0.9	1.9 ± 1.3	0.2162
Lactate (mml/l)	2.6 ± 0.9	3.0 ± 0.2	2.5 ± 0.8	0.4054
Intratoracic stomach volume (%)	84.1 ± 17.1	78.4 ± 16.4	80.1 ± 13.2	0.6973
Gastric tube production (cc)	1,896 ± 1,827	1,714 ± 942	1,920 ± 2,175	0.3883
Emergency surgery[&] (%)				
Yes	61.1	68.1	55.6	**0.003**
No	38.9	31.9	44.4	
Laparoscopic approach (%)				
Yes	12.7	30.1	7.6	**< 0.001**
No	87.3	69.9	92.4	
Surgical time (min)	165 ± 67	198 ± 77	140 ± 67	0.0860
Length of hospital stay (days)	7.9 ± 5.3	8.2 ± 2.7	7.9 ± 6.1	0.4611
POC (%)	32.0 ± 24.1	33.0 ± 24.8	28.4 ± 23.1	0.1632
Re-interventions (%)	7.6 ± 2.6	3.2 ± 3.5	14.9 ± 8.6	**0.0350**
30DM (%)	5.7 ± 2.9	4.1 ± 3.4	6.7 ± 5.9	0.2841
Readmissions (%)	11.0 ± 7.7	56.9 ± 6.6	11.5 ± 7.4	**0.0001**
Follow-up (months)	15.7 ± 10.7	14.6 ± 9.8	17.0 ± 11.9	0.2146
Recurrence (%)	22.2 ± 5.9	16.4 ± 4.6	8.9 ± 6.7	**0.0083**
MQ MInCir-T scale (points)	8.9 ± 2.3	9.1 ± 2.6	8.9 ± 2.2	0.5943
MQ MInCir-Pr$_2$ scale (points)	13.4 ± 5.4	13.3 ± 5.4	13.5 ± 5.4	0.8161

p* *p*-value for the comparison of averages between the periods 1990–2015 and 2016–2024

[&] Surgery within 24 h after admission

** There are a couple of studies with a large number of patients who underwent open surgery

*** thoracic and robotic approach

POC: postoperative complications

30DM: 30-day mortality

Non-significant trends suggested slight improvements in surgical time and POC, but a worsening of 30DM (Table 5).

Possible biases in the review process Additional information was requested from the authors to expand or verify certain study data; however, no response was received. As a result, missing data may introduce bias into this review. To mitigate the risk of missing studies, cross-references were thoroughly examined.

Risk of bias between studies There may be publication bias due to the concentration of studies originating from a few countries and limited global representation (Table 5). Finally, is important to highlight that only 4 studies for therapy and 6 on prognosis scores above the cut-off point defining acceptable MQ.

Discussion

Summary of the evidence This SR confirms that the prognosis for AGV/PEH remains poor, with high rates of morbidity and mortality despite advances in medical and surgical care.

There are several valuable reviews in the literature addressing the management of complicated diaphragmatic hernias, such as the one published outlining the WSES position on the topic [9]. However, studies specifically focused on AGV and PEH are limited [187, 188], and most examine populations different from the one analyzed in our SR.

The first SR included 97 studies focusing pediatric populations ($n = 125$; median age 24 months) [187]. Reported rates of mortality, postoperative complications, and recurrence were 6,4%, 18,9% and 0.8%, respectively. The second SR evaluated outcomes of surgery—elective or non-elective— based on eight retrospective cohort studies, involving 84 patients. It compared outcomes between 76 patients under 80 years of age (mean age 63.9 ± 9.5 years) and 8 patients aged 80 or older (mean age 85.4 ± 3.5

Table 6 Reported postoperative complications ($n = 1,989$ cases)*

Etiology	Nº	%
Deep vein thrombosis	490	24.6
Myocardial infarction	425	21.4
Pulmonary thromboembolism	374	18.8
Stroke	347	17.4
Atelectasis	62	3.1
Pneumonia	23	1.2
Sepsis / MODS	20	1.0
Cardiac arrhythmia	14	0.7
Surgical wound infection	12	0.6
Intra-abdominal hemorrhage	8	0.4
Gastrointestinal disorders	8	0.4
Pleural effusion	7	0.4
Others **	24	1.2
Etiology not reported	175	8.8
Total	**1,989**	**100**

*: This variable was not reported in all the articles (only in 71), and some patients developed more than one POC

**: Include: Acute renal failure and acute respiratory failure (4 cases each), Pneumothorax and intestinal occlusion (3 cases each), acute urinary infection, cardiac tamponade, anastomotic dehiscence, and cardiac arrest (2 cases each); acute cardiac failure and mediastinitis (2 case each)

MODS: Multiple organ dysfunction syndrome

NR: Not reported

years). The study found a significantly higher proportion of type IV hernias in ≥ 80 age patients (50.0% vs. 14.5%, $p = 0.037$) as well as a higher rate of emergency surgery (37.5% vs. 11.8%, $p = 0.049$). Although the emergency surgery group included only three octogenarians, this subgroup demonstrated longer hospital stays (median 9 vs. 5 days, $p = 0.049$) and significantly higher in-hospital mortality (25.0% vs. 0.0%, $p < 0.001$) compared to younger patients [188].

In this context, we believe ours is the first SR specifically focused on AGV secondary to PEH in adults. It compiles data from six major sources spanning 35 years, encompassing 167 primary studies and a total of 14,989 patients. Notably, more than half of the included studies originate from just four countries: the United States, Japan, Spain, and the United Kingdom.

A key strength of our SR is the inclusion of a temporal analysis aimed at assessing the potential impact of recent technical improvements. To this end, we com-pared outcomes across two potential periods (pre- and post-2015) and found no significant improvements in clinical outcomes. Notably, half of the patients included in the 35-years period study were treated in the last decade, suggesting that advances in surgical techniques may lead to a shift toward operative management over conservative approaches. This trend likely coincides with an aging global population, in which acute presentations are increasingly common. In fact, mortality increased in the more recent period (6.7% vs. 4.1%), likely due to an older and more frail patient population (mean age: 77.6 vs. 70.1 years). Morbidity remained high at 33%, with most complications classified as severe (Clavien-Dindo ≥ IIIa). On a more positive note, readmission and recurrence rates did show significant improvement after 2015.

Interestingly, mortality was higher in the more recent period (6.7% vs. 4.1%), likely reflecting the treatment of

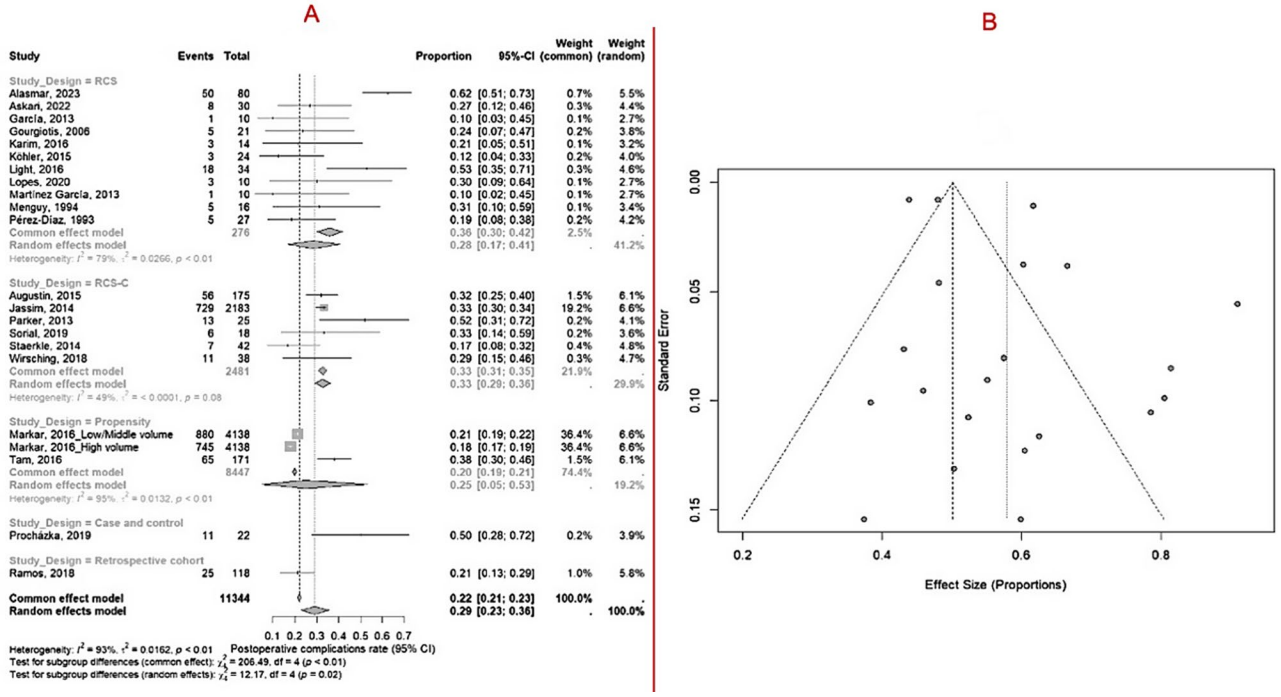

Fig. 2 Meta-analyses of prevalence of POC. **A**) Forrest plot. POC rate was 30% (95% CI: 23-37%). **B**) Funnel plot. There was great heterogeneity (I^2: 94%)

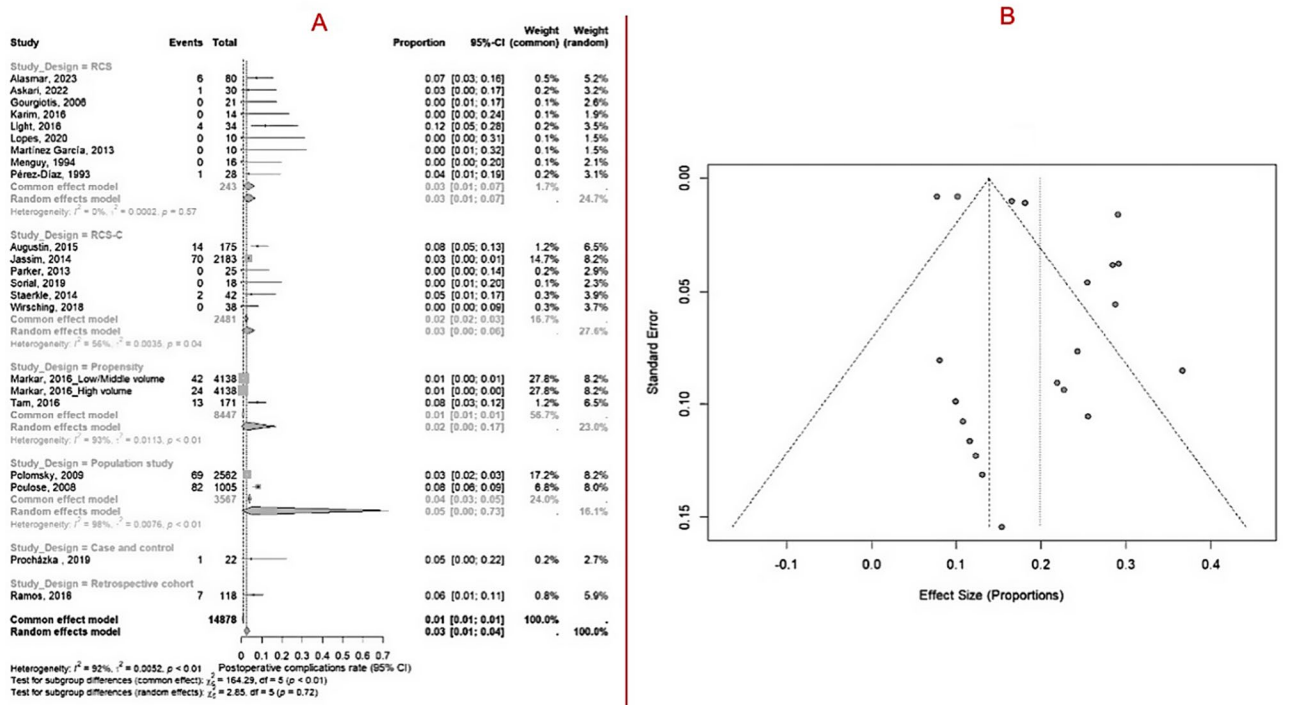

Fig. 3 Meta-analyses of prevalences of 30-day mortality. **A**) Forrest plot. 30DM rate was 3% (95% CI: 2-5%). **B**) Funnel plot. There was great heterogeneity (I^2: 93%)

older and more medically complex patients (mean age: 77.6 vs. 70.1 years). Morbidity remained substantial at 33%, with the majority of complications classified as severe (Clavien-Dindo ≥ IIIa). On a more encouraging note, both readmission and recurrence rates showed significant improvement after 2015.

In summary, in the adult population, the overall prognosis for AGV secondary to PEH does not appear to have improved substantially, although some indicators suggest a modest trend toward better outcomes, despite advances in resuscitation and surgical techniques. Perhaps most concerning is the inability to clearly identify prognostic variables—other than age—that would allow healthcare professionals to stratify patients and tailor treatment based on individual risk profiles [189].

Limitations The available evidence is limited to level 4 studies, including case reports and small retrospective series. The inclusion of case reports in a SR is debatable. From a strict methodological standpoint, their inclusion is generally discouraged; how-ever, in the context of rare or low-prevalence conditions, there is a degree of consensus that such an approach is appropriate [190, 191]. In this review, case reports contributed valuable clinical data, preoperative evaluation and surgical procedure details that might have otherwise gone unnoticed.

Conducting subgroup analyses would have been valuable—particularly to better under-stand the impact of the surgical approach, the specific techniques employed, and the surgical volume or experience of the teams involved in esophagogastric and/or thoracic procedures. Unfortunately, such information was not consistently reported.

Moreover, the methodological quality of the primary studies was generally poor, with MInCir-T and MInCir-Pr_2 scores below respective thresholds [16, 17]. Publication bias is also evident as the asymmetrical distribution in funnel plots observed in the meta-analyses of POC and mortality outcomes.

Notably, just four countries—one from North America, two from Europe, and one from Asia—accounted for 90 of the included studies; 52.6% of the studies included in this review. These studies collectively involved 14,861 patients (97.9% of the total sample), introducing a representativeness bias and significantly limiting the external validity of the findings. Additionally, not all studies reported data for the variables under analysis, reducing the completeness and representativeness of the summary statistics for each variable. Finally, although several high-impact studies with large patient cohorts were included, they often provided limited detail on key variables. Due to their size, these studies had a disproportionate influence on the overall results.

Conclusions AGV, a severe complication of PEH, continues to carry a poor prognosis despite medical advancements. Outcomes are characterized by prolonged hospital stays, high rates of severe complications, and substantial

mortality. Early diagnosis and prompt treatment appear to be critical for improving clinical outcomes.

Acknowledgements
None.

Author contributions
CM: Conceptualization, data collection, extraction, analysis, prepared Figs. 1, 2 and 3, and manuscript writing. EB: Data collection and extraction, manuscript preparation and review. JR: Conceptualization, data collection, analysis, manuscript preparation, prepared Figs. 1, 2 and 3, and review.MP: Conceptualization, overall project supervision and manuscript review.LG: Conceptualization, analysis, overall project supervision and manuscript review.

Funding
There was no Funding.

Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Author details
[1]Center for Morphological and Surgical Studies, Universidad de La Frontera, Temuco, Chile
[2]PhD. Program in Medical Science, Universidad de La Frontera, Temuco, Chile
[3]Department of Surgery, Universidad de Concepción, Concepción, Chile
[4]Department of Surgery, Universitat Autònoma de Barcelona, Barcelona, Spain
[5]Section of Gastrointestinal Surgery, Hospital del Mar, Barcelona, Spain
[6]Zero Biomedical Research, Quito, Ecuador
[7]Hospital del Mar Research Institute (IMIM), Barcelona, Spain
[8]Reial Acadèmia de Medicina de Catalunya, Barcelona, Spain

Received: 24 March 2025 / Accepted: 29 April 2025
Published online: 19 May 2025

References

1. Daly S, Kumar SS, Collings AT, Hanna NM, Pandya YK, Kurtz J, Kooragayala K, Barber MW, Paranyak M, Kurian M, Chiu J, Ansari MT, Slater BJ, Kohn GP. SAGES guidelines for the surgical treatment of hiatal hernias. Surg Endosc. 2024;38:4765–75.
2. Stylopoulos N, Gazelle GS, Rattner DW. Paraesophageal hernias: operation or observation?? Ann Surg. 2002;236:492–500.
3. Markar SR, McKensie H, Huddy JR, Jamel S, Askari A, Faiz O, Hanna GB, Zaninotto G. Practice patterns and outcomes after hospital admission with acute Para-esophageal hernia in England. Ann Surg. 2016;264:854–61.
4. Wong LY, Parsons N, David EA, Burfeind W, Berry MF. The impact of age and need for emergent surgery in paraesophageal hernia repair outcomes. Ann Thorac Surg. 2023;116:138–45.
5. Augustin T, Schneider E, Alaedeen D, Kroh M, Aminian A, Reznick D, et al. Emergent surgery does not independently predict 30-Day mortality after paraesophageal hernia repair: results from the ACS NSQIP database. J Gastrointest Surg. 2015;19:2097–104.
6. Srikrishnaraj D, Hawel J, Schlachta CM, Elnahas A. Fundoplication vs. gastric fixation for the management of emergency hiatal hernia repairs: a retrospective cohort study. Surg Endosc. 2024;38:5596–600.
7. Sherrill W 3rd, Rossi I, Genz M, Matthews BD, Reinke CE. Non-elective paraesophageal hernia repair: surgical approaches and short-term outcomes. Surg Endosc. 2021;35:3405–11.
8. Klinginsmith M, Jolley J, Lomelin D, Krause C, Heiden J, Oleynikov D. Paraesophageal hernia repair in the emergency setting: is laparoscopy with the addition of a fundoplication the new gold standard? Surg Endosc. 2016;30:1790–5.
9. Giuffrida M, Perrone G, Abu-Zidan F, Agnoletti V, Ansaloni L, Baiocchi GL, Bendinelli C, Biffl WL, Bonavina L, Bravi F, Carcoforo P, Ceresoli M, Chichom-Mefire A, Coccolini F, Coimbra R, et al. Management of complicated diaphragmatic hernia in the acute setting: a WSES position paper. World J Emerg Surg. 2023;18:43.
10. Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. Int J Surg. 2021;88:105906.
11. Shea BJ, Reeves BC, Wells G, et al. AMSTAR 2: a critical appraisal tool for systematic reviews that include randomised or non-randomised studies of healthcare interventions, or both. BMJ. 2017;358:j4008.
12. Manterola C, Pineda V, Vial M, Losada H, Muñoz S. Surgery for morbid obesity: selection of operation based on evidence from literature review. Obes Surg. 2005;15:106–13.
13. Manterola C, Pineda V, Vial M, Astudillo P. Use of opioid analgesics in diagnosis and decision-making in patients with acute nontraumatic abdominal pain. A systematic review of the literature. Cir Esp. 2007;81:91–5.
14. Clavien PA, Barkun J, de Oliveira ML, et al. The Clavien-Dindo classification of surgical complications: five-year experience. Ann Surg. 2009;250:187–96.
15. CEBM. Oxford Centre for Evidence-Based Medicine. Levels of Evidence (March 2009). Available at: https://www.cebm.ox.ac.uk/resources/levels-of-evidence/oxford-centre-for-evidence-based-medicine-levels-of-evidence-march-2009
16. Manterola C, Cartes-Velásquez R, Otzen T. Instructions for the use of mincir scale to assess methodological quality in therapy studies. Int J Morphol. 2015;33:1463–7.
17. Manterola C, Cartes-Velásquez R, Otzen T. Instructions for the use of mincir scale to assess methodological quality in prognosis studies. Int J Morphol. 2015;33:1553–8.
18. Abbood A, Al Salihi H, Parellada J, Madruga M, Carlan SJ. A large intrathoracic hiatal hernia as a cause of complete heart block. Case Rep Cardiol. 2021;2021:6697016.
19. Abraldes A, Rodríguez Ramos C, García Trujillo I, Fernández Collado JJ, Ramírez F, González V. Intrathoracic location of mixed-type acute gastric volvulus. Rev Esp Enferm Dig. 2007;99:231–2.
20. Alamowitch B, Christophe M, Bourbon M, Porcheron J, Balique JG. Paraesophageal hiatal hernia with acute gastric volvulus. Gastroenterol Clin Biol. 1999;23:271–4.
21. Akbar S, Kahloon A, Panda M. A twist in the Tale or a twist in the belly? Am J Gastroenterol. 2015;110:S532.
22. Alamowitch B, Christophe M, Bourbon M. Para-esophagal hiatus hernia with acute gastric volvulus. Gastroenterol Clin Biol. 1999;23:271–4.
23. Alamowitch B, Bourbon M, Porcheron J. Acute volvulus of the stomach on hiatal hernia revealed by a gall stone in the main bile duct. J Chir. 1995;132:454–8.
24. Alasmar M, McKechnie I, Chaparala RPC. Emergency surgery for hiatus hernias: does technique affect outcomes? A singlecentre experience. Updates Surg. 2023;75:1227–33.
25. Al-Balas H, Hani MB, Omari HZ. Radiological features of acute gastric volvulus in adult patients. Clin Imaging. 2010;34:344–7.
26. Albloushi D, Quttaineh D, Alsafran S, et al. Acute gastric volvulus: A rare case report and literature review. Ann Med Surg. 2021;70:102857.
27. Al Daoud F, Daswani GS, Perinjelil V, Nigam T. Acute organoaxial gastric volvulus: A massive problem with a twist-case report. Int J Surg Case Rep. 2017;41:366–9.
28. Altonbary AY, Bahgat MH. Acute mesenteroaxial gastric volvulus: A rare cause of haematemesis. Arab J Gastroenterol. 2016;17:53–5.
29. Amarnath S, Polavarapu A, Lan G. The story of an organoaxial gastric volvulus with an unexpected «twist». Am J Gastroenterol. 2020;115(Suppl):pS1553.
30. Ascherman B, Condiles N, Ma M. Gastric volvulus developing in previously asymptomatic paraesophageal hernia. Am J Gastroenterol. 2021;116(Suppl):S1304.
31. Askari A, Tezcan E, Patel K, et al. Management and outcomes in gastric volvulus: A tiered approach. Dig Disease Interventions (DDI). 2022;6:323–30.

32. Aslam S, Alani M, Ansari Z, Jacob M, Indu S, Keng-Yu C. Gastric volvulus: an underrated complication of hiatal hernia. Am J Gastroenterol. 2021;116(Suppl):S1301.
33. Augustin T, Schneider E, Alaedeen D, et al. Emergent surgery does not independently predict 30-Day mortality after paraesophageal hernia repair: results from the ACS NSQIP database. J Gastrointest Surg. 2015;19:2097–104.
34. Ayad N, Rojas PG, Almeida NEC. Twisted infarction. Am J Gastroenterol. 2017;112:S1390.
35. Aydin M, Yasar M, Aslaner A, et al. Volvulated paraoesophageal gastric herniation with perforation into bursa omentalis: report of a case. Acta Chir Belg. 2006;106:257–60.
36. Balzano RF, Testini V, Lattanzio F, Guglielmi G. Mesentero-axial gastric volvulus in an old woman: a case report of a diagnostic challenge. Acta Biomed. 2022;93:e2022339.
37. Bathobakae L, Jariwala M, Hajdarmataj E, Yuridullah R, Melki G, Cavanagh Y, Baddoura W. Acute Mesentero-Axial gastric volvulus in the setting of a paraesophageal hernia: A rare case report. J Investig Med High Impact Case Rep. 2023;11:23247096231220469.
38. Bauer K, Keller C. Organoaxial gastric volvulus: A rare cause of an acute abdomen. GMS Interdiscip Plast Reconstr Surg DGPW. 2019;8:Doc04.
39. Bawahab M, Mitchell P, Church N, Debru E. Management of acute paraesophageal hernia. Surg Endosc. 2009;23:255–9.
40. Black TP, Verma LM. A twisted tale: chronic abdominal pain caused by gastric volvulus. Am J Med. 2014;127:e19.
41. Blum MG, Sundaresan RS. Giant hiatal hernia with gastric volvulus complicating pneumonectomy. Ann Thorac Surg. 2006;81:1491–2.
42. Bolliet M, Katuwal B, Kolachalam R. Gastric necrosis secondary to gastric volvulus in a paraesophageal hernia: a case report. J Surg Case Rep. 2024;2024:rjae072.
43. Bozkurt B, Dumlu EG, Kiyak G, Ozkardez AB, Kilic M. Gastric volvulus due to paraesophageal hernia: A case report. Turk Acil Tip Derg. 2013;13:189–91.
44. Brown A, Austin D, Kanakala V. Cardiac compression due to gastric volvulus: an unusual cause of chest pain. BMJ Case Rep. 2017;2017:bcr2017219595.
45. Bhusal A, Bhattarai HB, Yogi TN, Kc S, Katwal S, Bam PK. Acute gastric volvulus in adults: A rare case report and a comprehensive review. Radiol Case Rep. 2024;19:5916–21.
46. Cairns DA, Hulme-Moir M. A case report of acute gastric volvulus with avulsion of the Splenic vessels. Scott Med J. 2003;48:123–4.
47. Cardile AP, Heppner DS. Gastric volvulus, Borchardt's triad, and endoscopy: A rare twist. Hawaii Med J. 2011;70:80–2.
48. Caruso G, Caramma S, Zappalà A, et al. Acute intrathoracic gastric volvulus with retrograde gastric intussusception: A case report of a rare surgical emergency with review of the literature. Int J Surg Case Rep. 2020;72:381–5.
49. Casey P, Casey MT. Simultaneous pyloric and colonic obstruction associated with hiatus hernia in a weightlifter: A case report. Can J Surg. 1999;42:220–2.
50. Castellanos Suárez J, Valls Figueroa CT, Sánchez Torres O. Hernia Paraesofágica Con vólvulo Gástrico. Rev Cub Med Mil. 2016;45:1–7.
51. Channer LT, Squires GT, Price PD. Laparoscopic repair of gastric volvulus. JSLS. 2000;4:225–30.
52. Chau B, Dufel S. Gastric volvulus. Emerg Med J. 2007;24:446–7.
53. Chauhan S. An unusual case of an acute mesenteroaxialcgastric volvulus secondary to a hiatal hernia. Cureus. 2022;14:e31296.
54. Cheema U, Brandt L. Acute ischemic colitis caused by transhiatal herniation and incarceration of the stomach and transverse colon. Am J Gastroenterol. 2012;107:S488.
55. Chen CT, Huang TW, Chang WK. Intrathoracic gastric volvulus. QJM. 2013;106:963–4.
56. Chiyonaga S, Ohya Y, Inoue M, et al. Incarceration of a part of the gastric wall into the abdominal cavity in a patient with hiatal hernia and complete dislocation of the stomach (upside-down stomach). DEN Open. 2024;5:e377.
57. Chowdhury N, Alom MS, Saleem A. Acute esophageal necrosis secondary to intrathoracic gastric volvulus without deadly outcome. Am J Gastroenterol. 2019;114:S1024.
58. Çiyiltepe H, Gündeş E, Çetin DA, Aday U, Bozdağ E, Çiyiltepe F. Giant paraesophageal hernia-related chronic gastric volvulus case to the emergent surgery. Prz Gastroenterol. 2017;12:315–7.
59. Cockbain AJ, Darmalingum A, Mehta SP. Acute deterioration after emergency paraesophageal hernia repair. Surgery. 2016;159:1691–2.
60. Comune R, Guida F, Marte G, et al. Gastric outlet obstruction in uncomplicated mesentero-axial gastric volvulus associated to hiatal hernia. Radiol Case Rep. 2024;19:2698–702.
61. Danushka PGN, Jayasinghe R. A case report on secondary mesentero-axial gastric volvulus. SAGE Open Med Case Rep 2022;10.
62. Day A, Sayegh M. Acute oesophageal necrosis: A case report and review of literature. Int J Surg. 2010;8:6–14.
63. De U, De KK. Acute gastric volvulus: a report of eight cases. J Indian Med Assoc. 2011;109:99–100.
64. Deliwala SS, Hussain MS, Ponnapalli A, Bachuwa G, Gurwits GE. Black esophagus, upside-down stomach and Cameron lesions: cascade effects of a large hiatal hernia. BMJ Case Rep. 2021;14:e246496.
65. Deressa BK, Bruyninx L, Ngassa M, Thill V, Toussaint E. Uncommon cause of retrosternal pain. Acta Gastroenterol Belg. 2016;79:251–3.
66. Di Saverio S, Smerieri N. Laparoscopic reduction and repair of a large incarcerated paraesophageal hernia. CMAJ. 2014;186:E400.
67. Doğan NO, Aksel G, Demircan A, Keleş A, Bildik F. Gastric volvulus due to diaphragmatic eventration and paraesophageal hernia. Turk J Med Sci. 2010;40:825–8.
68. Etti AGB. Acute gastric volvulus-a rare complication of a paraesophageal hernia. Am J Gastroenterol. 2019;114:S1529.
69. Fanjul F, Sampériz G. Acute gastric volvulus presenting as a pseudo cardiac tamponade. BMJ Case Rep. 2018;2018:bcr2018225556.
70. Ferreira-Bicalho LA, Ribeiro MA Jr, De Azevedo-Bicalho PR, Rodrigues-Bicalho PR. Laparoscopic gastropexy for the treatment of gastric volvulus. GED Gastrentologia Endosc Dig. 2010;29:69–72.
71. Foscolo PP, Santoro P. A complicated paraesophageal diaphragmatic hernia. A clinical case report. Minerva Chir. 1998;53:523–6.
72. Fukase K, Iseki M, Morikawa T, Sato S, Tominaga T. Unno. Total gastrectomy for acute organoaxial gastric volvulus. Jpn J Gastroenterol Surg. 2011;44:963–9.
73. Fukita Y, Ishibashi H, Yasuda I, Asaki T, Adachi S, Toyomizu M, Katakura Y. Upside-down stomach repositioned and fixed by colonoscopy-assisted percutaneous endoscopic gastrostomy. Endoscopy. 2014;46(Suppl 1 UCTN):E388.
74. García RM, Tomás NP, Del Pozo CD, et al. Laparoscopic treatment of acute gastric volvulus. Cir Esp. 2013;91:189–93.
75. Garcipérez de Vargas FJ, Moyano Calvente SL, Marcos G. Hydropneumomediastinum secondary to gastric volvulus perforation in a patient with giant hiatal hernia. Arch Bronconeumol. 2014;50:154.
76. George D, Apostolos PV, Athanasios P, et al. Struggling with a gastric volvulus secondary to a type IV hiatal hernia. Case Rep Med. 2010;2010:257497.
77. Ghosh RK, Fatima K, Ravakhah K, Hassan C. Gastric volvulus: an easily missed diagnosis of chest pain in the emergency room. BMJ Case Rep. 2016;2016:bcr2015213888.
78. Gill K, Wozny D, Gill S. Percutaneous endoscopic gastrostomy fixation of intrathoracic gastric volvulus and giant paraesophageal hernia. Pract Gastroenterol. 2023;47:52–66.
79. Gourgiotis S, Vougas V, Germanos S, Baratsis S. Acute gastric volvulus: diagnosis and management over 10 years. Dig Surg. 2006;23:169–172.
80. Gryglewski A, Kuta M, Pasternak A, Opach Z, Walocha J, Richter P. Hiatal hernia with upside-down stomach. Management of acute incarceration: case presentation and review of literature. Folia Med Cracov. 2016;56:61–6.
81. Guillén-Paredes MP, Pardo-García JL. Acute gastric volvulus: A case report. Rev Esp Enferm Dig. 2015;107:173–4.
82. Haas O, Rat P, Christophe M, Friedman S, Favre JP. Surgical results of intrathoracic gastric volvulus complicating hiatal hernia. Br J Surg. 1990;77:1379–81.
83. Haddad MC, Youssef BA, Sammak BM, Duff A. Right intrathoracic stomach secondary to congenital hiatal hernia and organoaxial torsion. Am J Roentgenol. 1996;167:66–8.
84. Hána L, Kasalický M, Koblihová E, Suchánek Š, Horažďovský P, Ryska M. Urgent surgical treatment of gastric volvulus related to upside-down stomach syndrome. Rozhl Chir. 2015;94:531–4.
85. Hare M, Salas-Parra R, Neal J, Patel V. Acute idiopathic mesenteroaxial gastric volvulus managed laparoscopically. BMJ Case Rep. 2024;17:e260253.
86. Hassan A, Azhar A, Ullah A, et al. Gastric organoaxial volvulus: A lethal twist and a rare cause of acute abdomen. Radiol Case Rep. 2023;18:4076–9.
87. Hibbard ML, Begossi G, Suding P, et al. Lethal acute gastric volvulus masquerading in the medical unit is managable with a laparoscopic approach. Surg Endosc Interv Tech. 2012;26:S316.
88. Hirooka M, Kurose K, Okabe S, et al. An adult case of acute organoaxial gastric volvulus. Nihon Shokakibyo Gakkai Zasshi. 2002;99:1455–9.
89. Ho MP, Tsai KC, Cheung WK, Chou AH. Hiatal hernia with gastric volvulus and small bowel strangulation. J Am Geriatr Soc. 2014;62:994–5.
90. Houissa F, Haddad W, Mouelhi L, et al. Spontaneous intrathoracic gastric volvulus: a rare emergency easily overlooked. Tunis Med. 2014;92:427–8.

91. Iannelli A, Fabiani P, Karimdjee BS, Habre J, Lopez S, Gugenheim J. Laparoscopic repair of intrathoracic mesenterioaxial volvulus of the stomach in an adult: report of a case. Surg Today. 2003;33:761–3.
92. Inaba K, Sakurai Y, Isogaki J, Komori Y, Uyama I. Laparoscopic repair of hiatal hernia with mesenterioaxial volvulus of the stomach. World J Gastroenterol. 2011;17:2054–7.
93. Izumo W, Ohta M, Narumiya K, Shirai Y, Kudo K, Yamamoto M. A case of esophageal hiatus hernia with change of upside down stomach over time. Nihon Shokakibyo Gakkai Zasshi. 2013;110:81–7.
94. Jacob CE, Lopasso FP, Zilberstein B, et al. Gastric volvulus - A review of 38 cases. ABCD Arq Bras Cir Dig. 2009;22:96–100.
95. Jaafar N, Sharma R, Sairam J, Duddu A. Volvulus is stressful: Stress-Induced cardiomyopathy secondary to gastric volvulus and paraesophageal hernia. Cureus. 2024;16:e61031.
96. Jamil LH, Huang BL, Kunkel DC, Jayaraman V, Soffer EE. Successful gastric volvulus reduction and gastropexy using a dual endoscope technique. Case Rep Med. 2014;2014:136381.
97. Januschowski R. Endoscopic repositioning of the upside-down stomach and its fixation by percutaneous endoscopic gastrostomy. Dtsch Med Wochenschr. 1996;121:1261–4.
98. Jassim H, Seligman JT, Frelich M, et al. A population-based analysis of emergent versus elective paraesophageal hernia repair using the nationwide inpatient sample. Surg Endosc. 2014;28:3473–8.
99. Jo SY, Orosz E, Patel AV. Gastric outlet obstruction with a twist: an endoscopic visualization of acute gastric volvulus. Am J Gastroenterol. 2020;115(Suppl):S960.
100. Kaoukabi AE, Menfaa M, Hasbi S, Sakit F, Choho A. Acute gastric volvulus on hiatal hernia. Case Rep Surg. 2020;2020:4141729.
101. Karim MA, Maloney J, Ali A. Laparoscopic repair of intrathoracic stomach: clinical and Health-related quality of life outcomes. Surg Laparosc Endosc Percutan Tech. 2016;26:484–7.
102. Kawahara M, Maruyama T, Kaneko Y, Konno N, Kashimura H, Oda T. Mesentero-axial gastric volvulus treated with laparoscopic gastropexy: a case report. Surg Case Rep. 2023;9:20.
103. Koger KE, Stone JM. Laparoscopic reduction of acute gastric volvulus. Am Surg. 1993;59:325–8.
104. Köhler G, Koch O, Antoniou S, Emmanuel K, Pointner R. «Acute intrathoracic stomach!» how should we deal with complicated type IV paraesophageal hernias? Hernia. 2015;19:627–33.
105. Kram M, Gorenstein L, Eisen D, Cohen D. Acute esophageal necrosis associated with gastric volvulus. Gastrointest Endosc. 2000;51:610–2.
106. Kumar B, Kalra T, Namdeo R, Kumar Soni R, Sinha. Acute gastric volvulus: A vicious twist of tummy-case report. Int J Surg Case Rep. 2017. 3081–5.
107. Kuwano H, Hashizume M, Ohta M, Sumiyoshi K, Sugimachi K, Haraguchi Y. Laparoscopic repair of a paraesophageal hiatal hernia with gastric volvulus. Hepatogastroenterology. 1998;45:303–6.
108. Kyang LS, Srinivasan R, Singh V. Acute gastric volvulus with pneumatosis intestinalis and portal venous gas secondary to hiatus hernia induced gastric outlet obstruction. ANZ J Surg. 2019;89:E582.
109. Lamouliatte H, Bernard PH, Lefebvre P, Boulard A, Arnal JC, Saric J, Quinton A. Hiatal hernia with intrathoracic gastric volvulus as a rare cause of biliary obstruction. Gastroenterol Clin Biol. 1992;16:89–91.
110. Larssen KS, Stimec B, Takvam JA, Ignjatovic D. Role of imaging in gastric volvulus: Stepwise approach in three cases. Turk J Gastroenterol. 2012;23:390–3.
111. Lee JGH, Nap-Hill E, Bressler BB. Acute gastric volvulus disguised as an acute coronary syndrome. J Can Ass Gastroenterol. 2022;5:151–2.
112. Lee TC, Liu KL, Lin MT, Wang HP. Unusual cause of emesis in an octogenarian: organoaxial gastric volvulus associated with paraesophageal diaphragmatic hernia. J Am Geriatr Soc. 2006;54:555–7.
113. Lesquereux-Martínez L, Macías-García F, Ferreirro R, Martínez-Castro J, Gamborino-Caramés E, Beiras-Torrado A. Acute gastric volvulus: a surgical emergency. Rev Esp Enferm Dig. 2011;103:219–20.
114. Lew PS, Wong AS. Laparoscopic mesh repair of parahiatal hernia: a case report. Asian J Endosc Surg. 2013;6:231–3.
115. Light D, Links D, Griffin M. The threatened stomach: management of the acute gastric volvulus. Surg Endosc. 2016;30:1847–52.
116. Lin PY, Chang CC, Liu JD. A rare cause of periodic vomiting with hematemesis in a 36-Year-Old man. Gastroenterology. 2015;149:870–1.
117. Lo EYJ, Fung A, Lai EYL, Lau CH, Tong AKL. Gastric volvulus: two ends of the spectrum. Surg Pract. 2019;23:25–7.
118. Longchamp G, Andres A, Abbassi Z. Gastric necrosis following a hiatal hernia: A case report. Int J Surg Case Rep. 2021;79:108–11.
119. Lopes LR, Chaim FHM, Santos IGG et al. Video-Laparoscopic Treatment of Intrathoracic Gastric Volvulus. JSLS. 2020;24:e2020.00061.
120. Malik TF, Desai S, Shah P. Perforated gastric volvulus: A rare Life-Threatening complication of paraesophageal hernia. Am J Gastroenterol. 2022;117:e2289–90.
121. Martínez García R, Peris Tomás N, Del Domingo C, et al. Tratamiento Del vólvulo Gástrico Agudo mediante abordaje laparoscópico. Cir Esp. 2013;91:189–93.
122. Martínez-Pérez A, Garrigós-Ortega G, Gómez-Abril SA, Torres-Sánchez T, Uceda-Navarro D. Perforated gastric volvulus due to incarcerated paraesophageal hernia. Rev Gastroenterol Mex. 2014;79:204–6.
123. Masabarakiza JB, Zhu L, Gorur Y, Cardos B, Lorenzo-Villalba N, Ali D. An unusual case of acute dyspnoea: acute intrathoracic gastric volvulus with probable tension Gastrothorax. Eur J Case Rep Intern Med. 2021;8:002818.
124. Masjedizadeh AR, Alavinejad P. Endoscopic view in a patient with acute gastric volvulus. Endoscopy. 2015;47 Suppl 1 UCTN:E379.
125. Matsumoto N, Oki E, Morita M, Kakeji Y, Egashira A, Sadanaga N, Maehara Y. Successful treatment of acute esophageal necrosis caused by intrathoracic gastric volvulus: report of a case. Surg Today. 2009;39:1068–72.
126. McCarty TR, Goshua G, Ghali B. Acute gastric volvulus presenting as coffee ground emesis. Am J Gastroenterol. 2016;111:S1148.
127. Milne LW, Hunter JJ, Anshus JS, Rosen P. Gastric volvulus: two cases and a review of the literature. J Emerg Med. 1994;12:299–306.
128. Mistry V, Gamble EL, Chang J. Adult mesentero-axial gastric volvulus: case report. J Med Imaging Radiat Oncol. 2020;64:817–20.
129. Mori M, Akutsu Y, Hayashi H, et al. A case of 100-year-old woman successfully treated for upside down stomach with laparoscopic surgery. Jpn J Gastroenterol Surg. 2011;44:1389–96.
130. Nadkarni NA, Jayant M, D'Cruz S, Kaur R, Kaur R, Sachdev A. Unusual cause of acute chest pain. Indian J Gastroenterol. 2011;30:102.
131. Nagpal S, Magacha HM, Goenka P, Vedantam V. Acute gastric volvulus: A rare complication of hiatal hernia. Cureus. 2024;16:e66102.
132. Nakamoto H, Yokota R, Namba H, Ishikawa T, Yamada K, Hosoda M, Taguchi K. Difficult diagnosis and surgical procedure for scirrhous gastric Cancer complicated by Upside-Down stomach: A case report. Am J Case Rep. 2020;21:e926002.
133. Narala K, Banga S, Hsu M, Mungee S. Hiatal hernia mimicking ST elevation myocardial infarction. Cardiology. 2014;129:258–61.
134. Nunes G, Patita M, Fernandes V, Fonseca J. Paraesophageal hernia and gastric volvulus: an uncommon etiology of vomiting and upper Gastrointestinal bleeding. Rev Esp Enferm Dig. 2017;109:294–5.
135. Obeidat FW, Lang RA, Löhe F, et al. Esophageal leiomyomatosis combined with intrathoracic stomach and gastric volvulus. JSLS. 2009;13:425–9.
136. Paily A, Patel D, Lamb P. Boerhaave's syndrome secondary to gastric volvulus. Scott Med J. 2012;57:17.
137. Parkash O, Gill RC, Qaiser I, Rabbani MS, Chawala T, Zafar H. Gastric volvulus in adults in a tertiary care hospital Karachi, Pakistan: A case series. J Pak Med Assoc. 2021;71:1277–81.
138. Parker DM, Rambhajan A, Johanson K, Ibele A, Gabrielsen JD, Petrick AT. Urgent laparoscopic repair of acutely symptomatic PEH is safe and effective. Surg Endosc. 2013;27:4081–6.
139. Patel I, Tiba M, Companioni RAC, et al. Good history and high suspicion of gastric volvulus in patient with known hiatal hernia are key to better outcomes. Am J Gastroenterol. 2015;110:S542.
140. Pavone G, Tartaglia N, Di Lascia A, et al. Strangulated hiatal hernia remains a challenge in surgical emergency: literature review and our experience. Clin Exp Surg. 2020;8:51–7.
141. Polomsky M, Hu R, Sepesi B, et al. A population-based analysis of emergent vs. elective hospital admissions for an intrathoracic stomach. Surg Endosc. 2010;24:1250–5.
142. Poulose BK, Gosen C, Marks JM, et al. Inpatient mortality analysis of paraesophageal hernia repair in octogenarians. J Gastrointest Surg. 2008;12:1888–92.
143. Procházka V, Svaton R, Marek F, et al. Acute hiatal hernias. Rozhl Chir. 2019;98:207–13.
144. Qublan HS, Malkawi HY, Smadi AZ, Fraywan N. Gastric volvulus caused by paraesophageal hernia complicating mid-trimester pregnancy. Indian J Chest Dis Allied Sci. 2005;47:285–7.
145. Ramos GP, Majumder S, Ravi K, Sweetser S. Role of diagnostic preoperative upper Gastrointestinal endoscopy in radiologically confirmed gastric volvulus. Dig Dis Sci. 2018;63:3091–6.

146. Rajwana Y, Ezeh K, Ott W, Spira EB. Gastric volvulus, an important yet commonly overlooked etiology of upper Gastrointestinal bleeding: A case study. Cureus. 2022;14:e26976.
147. Rodefeld MD, Soper NJ. Parahiatal hernia with volvulus and incarceration: laparoscopic repair of a rare defect. J Gastrointest Surg. 1998;2:193–7.
148. Rozenberg J, Mir A, Mönkemüller K, Collier B, Grider D. A rare case of emphysematous gastritis secondary to Organo-Axial gastric volvulus associated with Sarcina ventriculi. ACG Case Rep J. 2024;11:e01295.
149. Sachar M, Arguetta E, Gurvits GE. Comprehensive review: acute esophageal necrosis in the setting of gastric volvulus. Dig Dis Sci. 2023;68:1672–6.
150. Sánchez-Pérez MA, Luque-De León E, Muñoz-Juárez M, Moreno-Paquentin E, Cordera-González De Cosío F, Maydón-González H. Laparoscopic therapy of gastric volvulus associated with hiatal hernia in the elderly patient. Rev Gastroenterol Mex. 2010;75:218– 22.
151. Sanekommu H, Siddiqui Z, Farrell A, Taj S, Saleh AB, Alsaadi E, Shah P. Gastric outlet obstruction caused by acute gastric volvulus: A rare complication of hiatal hernia. Cureus. 2023;15:e38609.
152. Schneider MH, Solis-Pazmino P, Maldonado P, Hamaoui M. Perforated mediastinal gastric volvulus: an uncommon complication of hiatal hernia. J Surg Case Rep. 2023;2023.
153. Shah NN, Mohsin M, Khursheed SQ, Farooq SS, Buchh AA, Quraishi AQ. Eventration of diaphragm with gastric volvulus: a case report. Cases J. 2008;1:404.
154. Shafii AE, Agle SC, Zervos EE. Perforated gastric corpus in a strangulated paraesophageal hernia: A case report. J Med Case Rep. 2009;3.
155. Singla S, Sugumar A. Loft Us C. A case of abdominal pain and vomiting due to gastric volvulus. Am J Gastroenterol. 2010;105:S172.
156. Siow SL, Chuah JS, Mahendran HA. Laparoscopic repair of paraesophageal hernia with organo-axial intrathoracic gastric volvulus. Asian J Endosc Surg. 2020;13:437–40.
157. Siu WT, Yau KK, Luk YW, Law BK, Li MK. Endoscopic reduction of a gastric volvulus associated with a paraesophageal hernia. Endoscopy. 2005;37:787.
158. Sorial RK, Ali M, Kaneva P, et al. Modern era surgical outcomes of elective and emergency giant paraesophageal hernia repair at a high-volume referral center. Surg Endosc. 2020;34:284–9.
159. Staerkle RF, Skipworth RJ, Hansen RD, Hazebroek EJ, Smith GS, Leibman S. Acute paraesophageal hernia repair: short-term outcome comparisons with elective repair. Surg Laparosc Endosc Percutan Tech. 2015;25:147–50.
160. Su CH, Chen LC, Hsieh JS, Lee JY. Organoaxial gastric volvulus caused by incarceration of a gastric stromal tumor in paraesophageal hiatal hernia. Am Surg. 2013;79:e312.
161. Tabib SM, Assadipoya K, Mansorian R, Nasehy N, Assadi M. Acute gastric volvulus presenting with gastric outlet obstruction and upper Gastrointestinal bleeding. Turk J Gastroenterol. 2013;24:293–5.
162. Tabo T, Hayashi H, Umeyama S, Yoshida M, Onodera H. Balloon repositioning of intrathoracic upside-down stomach and fixation by percutaneous endoscopic gastrostomy. J Am Coll Surg. 2003;197:868–71.
163. Takemura M, Mayumi K, Ikebe T, Hamano G. Laparoscopic repair of secondary parahiatal hernia with incarceration of the stomach: A case report. J Med Case Rep. 2013;7.
164. Tam V, Luketich JD, Winger DG, et al. Non-Elective paraesophageal hernia repair portends worse outcomes in comparable patients: a Propensity-Adjusted analysis. J Gastrointest Surg. 2017;21:137–45.
165. Tamburini N, Andolfi C, Vigolo C, et al. The surgical management of acute gastric volvulus: clinical outcomes and quality of life assessment. J Laparoendosc Adv Surg Tech A. 2021;31:247–50.
166. Teague WJ, Ackroyd R, Watson DI, Devitt PG. Changing patterns in the management of gastric volvulus over 14 years. Br J Surg. 2000;87:358–61.
167. Ter Avest E, Kamphuis DD, Sprakel J, Witteveen H, Hannivoort LN. Cardiac arrest caused by an acute intrathoracic gastric volvulus treated with percutaneous gastrostomy. Ann Emerg Med. 2021;77:249–52.
168. Tsuboi K, Tsukada K, Nakabayashi T, et al. Paraesophageal hiatus hernia, which has progressed for 8 years: report of a case. Hepatogastroenterology. 2002;49:992–4.
169. Uche-Anya E, Christopher P, Lee DS. Successful endoscopic reduction and fixation of gastric volvulus. Gastrointest Endosc. 2018;87:AB189.
170. Uemura T, Morishima R, Kanai N, et al. A case report: a case of hiatal hernia with upsidedown stomach treated with laparoscopic surgery. Dis Esophagus. 2022;35:62.
171. Umemura A, Suto T, Fujiwara H, et al. Cardiopulmonary impairments caused by a large hiatal hernia with organoaxial gastric volvulus showing Upside-Down stomach: A case report. Am J Case Rep. 2019;20:1530–5.
172. Van Olmen D, Somville F, Van der Mieren G. A rare cause of severe epigastric pain, emesis and increased lipase. Acta Chir Belg. 2018;118:254–7.
173. Vasile I, Dumitrescu T, Vîlcea ID, et al. Gastric volvulus–complication of a large paraesophageal hiatal hernia. Chirurgia (Bucur). 2006;101:635–9.
174. Villarreal R, Bernal F, Cabrera LF, Ussa SS, Pedraza M. Mixed hiatal hernia with intra thoracic gastric volvulus: case report and literature review. Rev Hispanoam Hernia. 2018;6:186–90.
175. Wijesuriya S, Watura R. Acute gastric volvulus: an uncommon complication of a hiatus hernia. BMJ Case Rep. 2011;2011:bcr0920114753.
176. Wirsching A, El Lakis MA, Mohiuddin K, Pozzi A, Hubka M, Low DE. Acute vs. Elective paraesophageal hernia repair: endoscopic gastric decompression allows Semi-Elective surgery in a majority of acute patients. J Gastrointest Surg. 2018;22:194–202.
177. Wozny D, Wright J, Dipollina C, Gill S, Weinstock C. Intrathoracic gastric volvulus and giant paraesophageal hernia with percutaneous endoscopic gastrostomy fixation. Am J Gastroenterol. 2021;116(Suppl):S1077.
178. Wu MH, Chang YC, Wu CH, Kang SC, Kuan JT. Acute gastric volvulus: a rare but real surgical emergency. Am J Emerg Med. 2010;28:e1185–7.
179. Yates RB, Hinojosa MW, Wright AS, Pellegrini CA, Oelschlager BK. Laparoscopic gastropexy relieves symptoms of obstructed gastric volvulus in high operative risk patients. Am J Surg. 2015;209:875–80.
180. Yau KK, Siu WT, Cheung HYS, Yang GPC, Li MK. Acute gastric volvulus: an unusual cause of gastric outlet obstruction. Minim Invasive Ther Allied Technol. 2005;14:2–5.
181. Yeh CM, Tsai KC, Huang CY. Case report of gastric volvulus (Twisted Stomach) with Borchardt's triad. Int J Gerontol. 2022;16:147–9.
182. Yousaf MN, Duffy AJ, Aslanian HR. Endoscopic diagnosis of paraesophageal hernia with gastric volvulus. VideoGIE. 2017;2:312–4.
183. Zachry A, Liu A, Raja S, et al. Type IV paraesophageal hiatal hernia and organoaxial gastric volvulus. McGill J Med. 2012;14:7–12.
184. Zanotti D, Fiorani C, Botha A. Beyond Belsey: complex laparoscopic hiatus and diaphragmatic hernia repair. Ann R Coll Surg Engl. 2019;101:162–7.
185. Zhu X, Hu C, Gong W. Upside-down stomach in paraesophageal hernia: A case report. Medicine. 2023;102:51.
186. Zuiki T, Hosoya Y, Lefor AK, et al. The management of gastric volvulus in elderly patients. Int J Surg Case Rep. 2016;29:88–93.
187. Miura da Costa K, Saxena AK. Management and outcomes of gastric volvulus in children: a systematic review. World J Pediatr. 2019;15:226–34.
188. Straatman J, Groen LCB, van der Wielen N, Jansma EP, Daams F, Cuesta MA, van der Peet DL. Treatment of paraesophageal hiatal hernia in octogenarians: a systematic review and retrospective cohort study. Dis Esophagus. 2018;31:7.
189. Hemingway H, Croft P, Perel P et al. Prognosis research strategy (PROGRESS) 1: A framework for researching clinical outcomes. BMJ 2013;346.
190. Jefferson T, Doshi P, Boutron I, Golder S, Heneghan C, Hodkinson A, Jones M, Lefebvre C, Stewart LA. When to include clinical study reports and regulatory documents in systematic reviews. BMJ Evid Based Med. 2018;23:210–7.
191. Moxon H, MacCarrick T, Eusuf D. Role of case reports in systematic reviews of perioperative complications. Br J Anaesth. 2022;128:e238–9.

Publisher's note