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Complications and underreported injuries after the Heimlich maneuver

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Abstract

Introduction: The Heimlich maneuver is a widely used, life-saving intervention for Foreign Body Airway Obstruction (FBAO). Although generally considered safe, a range of complications involving multiple organ systems has been reported. The true spectrum and distribution of these complications remain incompletely characterized. This systematic review aimed to categorize reported complications associated with the Heimlich maneuver and identify potential gaps and reporting biases within the literature.

Methods: A systematic review was conducted in accordance with PRISMA guidelines using three databases from inception through 2026. Screening and study selection were performed using Covidence software, only using studies describing complications temporally associated with the Heimlich maneuver or abdominal thrusts.

Complications were categorized by anatomical system; descriptive and subgroup analyses evaluated outcomes.

Results: A total of 49 studies met the inclusion criteria. Gastrointestinal injuries were the most frequently reported complications (n=20), including gastric and esophageal rupture or perforation. Vascular complications (n=11), such as abdominal aortic thrombosis, aortic dissection, and rupture. Additional injuries included solid organ injuries (n=4), thoracic complications (n=4), diaphragmatic injuries (n=3), cardiac or valvular injuries (n=2), mesenteric injuries (n=1), and functional complications (n=1). Fatal cases occurred in significantly older patients compared with survivors (median age 80 vs 61.5 years; P=0.011). Skeletal injuries were infrequently reported despite being commonly referenced in the literature, suggesting potential under recognition or publication bias.

Conclusion: Although complications associated with the Heimlich maneuver are uncommon, they may involve severe complications and occasionally result in mortality. Gastrointestinal and vascular injuries were the predominant reported complications, while skeletal injuries appeared underrepresented despite their frequent mention in prior literature. Increased awareness, proper training, and standardized reporting of Heimlich maneuver-associated complications may improve recognition of injuries and better define the true risk profile.

Introduction

Foreign Body Airway Obstruction (FBAO) is a life-threatening emergency that requires immediate intervention to prevent hypoxia and death. The Heimlich maneuver, first described in 1975 [1], remains one of the most widely taught and utilized techniques for relieving airway obstruction in both community and clinical settings. Dr. Heimlich described the potential for the most common injury, rib fracture [1,2]. FBAO is the 4th leading cause of unintentional deaths [3], creating a high demand for lifesaving maneuvers that everyone should be trained in. Its simplicity, effectiveness, and applicability to laypeople have contributed to its global adoption as a first-line response to choking [4].

Despite its life-saving potential, the Heimlich maneuver generates significant intra-abdominal and intrathoracic pressures, raising concern for possible injury to internal organs. Over the past several decades, a range of complications has been described in the literature, including gastrointestinal perforations, vascular injuries, and thoracic complications [1,2,5-15]. These reports, however, are largely limited to isolated case reports and small case series, making it difficult to fully characterize the true spectrum and relative frequency of associated injuries.

Existing summaries of Heimlich maneuver-related complications have identified several categories of injury, most commonly involving the gastrointestinal tract and major vascular structures. However, these reports often focus on severe or unusual cases and may not capture the full range of complications encountered in practice. There appears to be a discrepancy between commonly cited complications-such as rib fractures-and the relative absence of such injuries in published case reports. This raises the possibility of systematic underreporting of more common or less severe complications.

A comprehensive, structured evaluation of the literature is needed to better define the range of complications associated with the Heimlich maneuver and identify potential gaps in reporting. Such understanding is important for informing clinical awareness, guiding post-event evaluation, and improving patient safety without undermining the essential role of this intervention.

The objective of this study was to systematically review published reports of complications associated with the Heimlich maneuver, categorize these complications by anatomical and clinical classification, and assess patterns of reporting across the literature. Attention was given to identifying discrepancies between commonly cited and documented complications, with the aim of better characterizing the true spectrum of injury associated with this widely used life-saving technique.

Methods

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [16]. Literature screening, study selection, and data extraction were performed using Covidence systematic review software (Veritas Health Innovation, Melbourne, Australia). The review was not prospectively registered in Prospero.

Search strategy: A comprehensive literature search was performed using PubMed, Scopus, and EMBASE from database inception through January 31st 2026 to identify studies reporting complications associated with the Heimlich maneuver or abdominal thrusts. Medical Subject Headings (MESH) and free-text terms were used in various combinations, including "Heimlich maneuver," "abdominal thrusts," "foreign body airway obstruction," and **"**FBAO," combined with terms such as "complications," "injury," "trauma," "rupture," "perforation," "Fracture," and "pneumothorax."

Because skeletal injuries are frequently referenced but inconsistently reported in the literature, an additional targeted search using musculoskeletal injury–related terms (e.g., "rib," "fracture," and "osteoporosis") was performed to identify potentially underrecognized complications. Reference lists of included studies and relevant review articles were also manually screened to identify additional eligible studies not captured in the primary search. Only English-language studies involving human subjects were included. Detailed search strategy under the Supplementary PRISMA-S checklist.

Eligibility criteria: Eligible studies included case reports, case series, and observational studies describing complications associated with the Heimlich maneuver or abdominal thrusts. Studies were included if they: (i) reported a complication occurring immediately following or clinically attributed to the Heimlich maneuver or abdominal thrusts; (ii) contained original patient data; and (iii) provided sufficient clinical detail to characterize the reported injury. Studies were excluded if they: (i) focused solely on technique, training, or effectiveness without describing complications; (ii) described foreign body airway obstruction without associated injury; (iii) were review articles without original patient data, although their references were screened for additional studies; or (iv) did not clearly associate the reported injury with the Heimlich maneuver.

Study selection and data extraction: A total of 244 records were identified through database searching and imported into Covidence for duplicate removal and screening. Following duplicate removal, studies underwent title and abstract screening, followed by full-text review of potentially eligible articles. Two reviewers independently screened titles, abstracts, and full text studies. Disagreements were resolved through consensus. Following full-text assessment, 49 studies met the inclusion criteria and were included in the final analysis.

Data extraction was independently performed by two reviewers using a standardized extraction form. Extracted variables included patient demographics, medical history, complication type, mechanism of injury, clinical context, additional resuscitative measures performed, rescuer training status when available, presenting symptoms, timing of presentation, and patient outcomes. Variables not reported in the original publication were recorded as "not specified" and excluded from subgroup analyses.

Complication classification: Complications were categorized according to anatomical and clinical classification. Primary complication categories included gastrointestinal injuries, vascular injuries, solid organ injuries, thoracic injuries, diaphragmatic injuries, cardiac or valvular injuries, mesenteric injuries, skeletal or musculoskeletal injuries, and functional

or non-structural complications. Contextual findings included mixed-mechanism injuries involving concomitant cardiopulmonary resuscitation, imaging-based or suspected injuries without definitive confirmation, and rescuer-related injuries.

Quality assessment: Given the predominance of isolated case reports and case series, a formal risk-of-bias assessment was not performed. Many included reports lacked complete documentation of patient comorbidities, rescuer training status, timing of symptom onset, or concurrent resuscitative interventions. These reporting inconsistencies limited assessment of causality and prevented standardized quality evaluation across studies. Publication bias toward severe, unusual, or fatal complications was anticipated because less severe injuries may be underreported in the literature.

Statistical analysis

Because of substantial heterogeneity in study design, injury type, and outcome reporting, formal meta-analysis was not performed. Instead, a descriptive synthesis was conducted using frequency counts and categorical comparisons.

Descriptive statistics were used to summarize patient demographics, complication categories, and outcomes. Continuous variables were summarized using medians and ranges due to the small sample size and nonnormality of the case-based data. Categorical variables were summarized using frequencies and percentages.

Comparisons between groups were performed using the Mann-Whitney U test for continuous variables and Fisher's exact test for categorical variables. Statistical significance was defined as a two-sided P value < 0.05. Cases with missing or unspecified variables were excluded from subgroup analyses involving those variables.

Results

A total of 49 studies met the inclusion criteria, consisting predominantly of isolated case reports and small case series describing complications temporally associated with the Heimlich maneuver (Figure 1). Across these studies, 51 patients were identified, aged 3 to 93 years (Table 1). Among published complication cases included in this review, 41% resulted in fatal outcomes, although this likely reflects substantial publication bias toward severe presentations.

Patients with fatal outcomes were significantly older than survivors (median age 80 years [range 39-86] vs 61.5 years [range 3-93]; Mann-Whitney U test, P=0.011; Table 2). No significant association was identified between sex and mortality (Fisher's exact test, P=0.76). Although the observed fatality rate was numerically higher among cases in which the rescuer was reported as Heimlich-trained (50% vs 25%; Table 3), this difference was not statistically significant (Fisher's exact test, P=0.250). Interpretation of this finding is limited by the small sample size and incomplete reporting of rescuer training status.

Reported complications involved multiple organ systems, with gastrointestinal and vascular injuries representing the most frequently described categories (Table 4). Despite frequent reference to skeletal trauma in prior literature and educational discussions, confirmed skeletal injuries were rarely reported among published cases.

Gastrointestinal injuries: Gastrointestinal injuries were the most frequently reported complications (n=20) and included gastric, esophageal, and jejunal ruptures, perforations, or lacerations [11,14,15,17-31]. Four of the 20 gastrointestinal cases resulted in fatal outcomes [18,21,28,30]. Notably, all fatal gastrointestinal cases involved injury to the lesser curvature of the stomach.

Esophageal injuries were also commonly described [11,14,17,22,27], including both rupture and perforation. Several patients initially appeared clinically stable following abdominal thrusts but later presented hours to days afterward with chest pain, throat pain, vomiting, dyspnea, or dysphagia. One pediatric case demonstrated severe esophageal injury in an otherwise healthy child [27]. A rare case of jejunal rupture was additionally reported [15], illustrating the potential for small bowel injury following forceful abdominal compression.

Solid organ injuries: Solid organ injuries were less common (n=4) but were frequently severe and often required operative intervention. Reported injuries included pancreatic transection [32], pancreatic pseudocyst formation [33], hepatic rupture [34], and splenic rupture [35]. The splenic rupture case represented the only fatal solid organ injury and occurred in a patient who required CPR and intubation before rapidly deteriorating from hemorrhagic shock.

A pediatric patient developed a pancreatic pseudocyst approximately four weeks after abdominal thrusts [33], demonstrating the potential for delayed manifestation of injury. Hepatic rupture and subcapsular hematoma were also reported, with survival following surgical management [34].

Among reported cases, patients treated with abdominal thrusts alone demonstrated higher survival rates than those requiring additional resuscitative measures (77% vs. 46%; Fisher's exact test, P=0.048). However, this association likely reflects greater severity of the underlying choking event rather than harm directly attributable to the additional interventions.

One additional mixed-mechanism case described hepatic subcapsular hematoma following combined abdominal thrusts and cardiopulmonary resuscitation after drowning [36], making attribution to a single intervention difficult.

Delayed clinical presentation: Several complications demonstrated delayed clinical presentation, particularly esophageal, pancreatic, thoracic, and select vascular injuries (Table 5). In multiple reports, patients were initially stable following the Heimlich maneuver but later developed progressive symptoms requiring medical evaluation.

Patients with esophageal rupture or perforation frequently presented hours to days later with chest pain, dyspnea, vomiting, or dysphagia [14,17]. One pediatric patient developed a pancreatic pseudocyst approximately four weeks after the initial event [33]. Thoracic complications, including pneumomediastinum and emphysema, also occasionally presented after the delayed onset of chest discomfort or respiratory symptoms [9,37]. In contrast, severe vascular injuries and splenic rupture generally present with rapid hemodynamic deterioration.

Pediatric cases: Pediatric cases generally did not result in fatal outcomes despite several severe complications. However, multiple reports described an apparent inappropriate application of the maneuver by caregivers [9,32,38]. In one

case, abdominal thrust were performed on an 11-year-old boy experiencing gasping respirations caused by new-onset seizures, resulting in pancreatic transection [32]. Another report described vomiting and permanent neurologic injury after the maneuver was performed on a drowning victim before ventilation and resuscitation efforts were initiated [38].

Vascular injuries: Vascular injuries represented the second most frequently reported complication category (n=11) and included abdominal aortic thrombosis, aortic dissection, aortic rupture, embolization, aneurysm formation, and carotid artery dissection [13,39-47]. These injuries occurred predominantly in older patients and were associated with a relatively high proportion of fatal outcomes.

Patients with aortic thrombosis frequently presented with bilateral lower extremity pain, weakness, absent pulses, or motor deficits following abdominal thrusts. In two fatal cases [13,41], advanced atherosclerotic disease was identified on imaging or autopsy, suggesting that pre-existing vascular pathology may increase susceptibility to injury during abrupt increases in thoracoabdominal pressure. Additional vascular complications included cholesterol embolization [46], and carotid artery dissection [47].

When aortic complications were compared with non-aortic complications, a statistically significant association with mortality was identified (Fisher's exact test, $P < 0.01$), with aortic injuries demonstrating substantially higher fatality rates. Interpretation remains limited by the small number of reported cases.

Cardiac and thoracic injuries: Cardiac and valvular complications were rare (n = 2) but clinically significant. Reported injuries included aortic valve rupture [10], and prosthetic valve disruption [48], both occurring in patients with underlying cardiac disease. One case resulted in a fatal outcome.

Thoracic pressure-related complications were uncommon (n = 4) and included pneumomediastinum [8,9], and emphysema [37,49]. These injuries were generally associated with favorable outcomes and occurred in both pediatric and adult patients.

Diaphragmatic, mesenteric, and skeletal injuries: Structural injuries involving the diaphragm and mesentery were infrequently reported. Diaphragmatic rupture or hernia occurred in three cases [12,50,51], while mesenteric laceration with intra-abdominal hemorrhage was reported in one case [52].

Skeletal and musculoskeletal complications were infrequently described despite repeated reference to such injuries in prior literature. Imaging findings suggestive of skeletal injury were described in two reports [53,54], while definite injuries-including vertebral compression fracture and sternal fracture-were identified in two additional cases [55,56]. One patient had a known history of vertebral fractures, potentially increasing susceptibility to injury. Notably, no confirmed rib fractures were identified among the included reports.

Additionally, one report described a mixed-mechanism hepatic injury following combined abdominal thrusts and cardiopulmonary resuscitation, making attribution to a single intervention difficult [36]. In addition to patient-related complications, one rescuer sustained a rotator cuff tear while performing the maneuver [57], demonstrating that injury risk may occasionally extend beyond the patient alone.

Temporal trends: When complications were examined by decade of publication, gastrointestinal and vascular injuries were consistently reported and accounted for most of the described complications. In contrast, skeletal injuries remained sporadically reported despite increasing publication of Heimlich maneuver-associated injuries and widespread availability of advanced imaging modalities (Figure 2). Several reports described imaging abnormalities suggestive of skeletal injury without definitive confirmation [53,54], raising the possibility that musculoskeletal complications may be underrecognized or underreported within the literature.

Overall, the available evidence suggests that complications associated with the Heimlich maneuver, although uncommon, may involve multiple organ systems and range in severity from minor pressure-related injuries to gastrointestinal or vascular rupture.

Table 1: Summary of included studies and reported complications.
Summary of the demographic characteristics, resuscitative measures performed, training status of the individual performing the Heimlich maneuver, reported complications, complication categories, and patient outcomes among included studies describing adverse events associated with the Heimlich maneuver.

Study (ID)	Age/Sex	Resuscitative measures	Heimlich maneuver trained	Complication*	Category	Status**
Agia, 1979 [8]	19/M	Not specified	Yes	Pneumomediastinum	Thoracic	S
Ayerdi, 2002 [39]	70/M	No	Not specified	Aortic	Vascular	S
Baker, 2010 [57]	48/M	No	Not specified	Rotator cuff tear (rescuer)	Rescuer	S
Basile, 2024 [17]	23/M	No	No	GI	GI	S
Bintz, 1996 [18]	65/F	No	No	GI	GI	S
Bintz, 1996 [18]	80/M	No	Yes	GI	GI	F
Cecchetto, 2011 [35]	83/M	Intubation and CPR	Yes	Splenic rupture	Solid organ	F
Chao, 2012 [19]	59/W	CPR, intubation	Yes	GI	GI	S
Chapman, 1983 [10]	86/M	No	No	Aortic	Cardiac	F
Chillag, 2010 [55]	80/F	No	No	Spinal fracture	Skeletal	S
Cowan, 1987 [20]	74/M	Mouth-to-mouth ventilation	Not specified	GI	GI	S
Croom, 1983 [21]	39/M	Mouth-to-mouth ventilation	Not specified	GI	GI	F

Deb roux, 2007 [22]	88/M	No	Not specified	Hepatic rupture	Solid organ	S
Deb roux, 2020 [22]	56/F	No	No	GI	GI	S
Desai, 2008 [44]	78/F	Intubation	Yes	Aortic	Vascular (suspected)	F
Dupre, 1993 [23]	93/M	CPR, BVM, Ventilation Intubation	Not specified	GI	GI	S
Entel, 1996 [53]	79/F	No	No	Possible skeletal injury	Skeletal	S
Fearing, 2002 [24]	74/F	No	Not specified	GI	GI	S
Feeney, 2007 [32]	11/M	No	No Not specified	Pancreatic transection	Solid organ Thoracic	S
Fink, 1989 [9]	3/M	No	Not specified	Pneumomediastinum	GI	S
Gallardo, 2003 [26]	66/F	Posterior ventilation		GI		S
Gutierrez, 2020 [25]	87/F	No	No	GI	GI	S
Haynes, 1984 [14]	61/F	No	No	GI	GI	S
Herman, 2018 [50]	85/F	No	Yes	Diaphragmatic rupture/hernia	Diaphragmatic	S
Koss, 2018 [27]	16/M	Not specified	Not specified	Pancreatic pseudocyst	GI	S
Lee, 2009 [33]	3/M	Not specified	Not specified	GI	Solid organ	S
Lee, 2019 [45]	67/M	No	Yes	Aortic	Vascular	S
Lette, 1990 [54]	72/F	Not specified	Not Possible	thoracic	S specified	S
Lin, 2003 [43]	63/M	No	Not	Aortic Vascular	specified	
Mack, 2002 [40]	80/F	Chest	Not	Aortic Vascular	F compressions	specified
Mack, 2002 [40]	84/M	No	Not	Aortic	Vascular	F specified
Majumdar, 1998 [28]	57/F	CPR	Yes	GI	GI	F
Martin, 2007 [41]	81/M	Intubation	Not	Aortic Vascular	F ventilation	specified
Matharoo, 2013 [51]	10/F	No	NO	Diaphragmatic	Diaphragmatic	S rupture/hernia
Meredith, 1986 [11]	62/M	NO	Yes	GI	GI	S
Monsuez, 2007 [36]	25/M	CPR	No	Liver hematoma & mechanism mouth-to-mouth	Mixed- S ventilation	laceration
Nowitz, 1998 [49]	7/M	No	Not	Emphysema Thoracic	S specified	
Olenchock, 2004 [37]	56/M	No	Not	Emphysema Thoracic	S specified	
Orlowski, 1987 [38]	10/M	CPR,	Yes	Vomiting	Functional	S intubation
Otero Palleiro, 2007 [34]	88/M	No	Yes	Hepatic rupture	Solid organ	S
Passik, 1987 [48]	74/F	No	Not	Prosthetic valve	S specified rupture	
Pawlukiewicz, 2020 [46]	56/F	No	Not	Aortic	Vascular	S
Rakotoharinandrasana, 2003 [47]	46/F	No	No	Aortic	Vascular	S
Razaboni, 1986 [15]	22/M	No	Yes	GI	GI	S
Roehm, 1983 [13]	62/M	No	No	Aortic	Vascular	F
Tappero, 2018 [42]	83/F	CPR	Yes	Aortic	Vascular	F ventilation
Tung, 2001 [29]	63/F	CPR	Not	GI	S intubation	specified
Tung, 2001 [29]	73/M	CPR	Not	GI	GI	S specified
Ujjin, 1984 [12]	middle	No	Yes	Diaphragmatic	F aged/M	rupture/hernia
Ülger, 2016 [56]	33/F	Did not	Not	Sternal fracture	Skeletal	S specify specified
Van Der Ham, 1990 [30]	76/F	Mouth-to-mouth	Yes	GI	GI	F
Visintine, 1975 [31]	74/M	No	Not	GI	GI	S specified
Wolf, 2001 [52]	51/M	No	No	Mesenteric laceration/hemorrhage	Mesenteric	F

All included studies were case reports. *Gastrointestinal (GI) includes rupture, perforation, or laceration; Aortic includes thrombosis, embolism, dissection, or aneurysm. ** S: Survived; F: Fatal.

Table 2: Sex, Age, and Fatality. Summary of patient sex distribution, survival outcomes, and fatality rates among reported cases of complications associated with the Heimlich maneuver. The fatality rate was calculated as the proportion of fatal cases within each sex category.

Sex	Survivors	Fatal	Total	Fatality rate
Male	21	8	29	27.60%
Female	17	5	22	22.70%

Table 3: Outcomes by training status. Summary of patient outcomes according to the reported training status of the individual performing the Heimlich maneuver. The fatality rate was calculated as the proportion of fatal outcomes within each training status category.

Heimlich-Trained	Survivors (S)	Fatal (F)	Total	Fatality rate
Yes	7	7	14	50.0%
No	9	3	12	25.0%

Table 4: Categorization and Frequency of Reported Complications of the Heimlich maneuver. Summary of the categorization of the reported complications associated with the Heimlich maneuver by organ system and injury type. For each category, the table summarizes the specific complications described in the literature, the number of reported cases, and the corresponding studies documenting these complications.

Category	Specific complications	Number of cases (n)	Studies
Gastrointestinal (Luminal)	Gastric rupture/perforation; esophageal rupture/perforation; jejunal rupture; gastric laceration; other GI perforation-type injuries	20	[11,14,15,17-31]
Vascular	Abdominal aortic thrombosis; aortic dissection/rupture; cholesterol embolization; arterial occlusion; carotid artery dissection; other major vascular injuries	11	[13,39-42,44-47]
Thoracic (Pressure related)	Pneumomediastinum; emphysema	4	[8,9,37,49]
Solid organ	Hepatic rupture; splenic rupture; pancreatic transection; pancreatitis/ pseudocyst	4	[22,32,33, 35]
Skeletal / Musculoskeletal	Rib fractures; sternal fracture; skeletal injuries	4 (5 if rescuer injury is included)	[53-57]
Diaphragmatic	Diaphragmatic rupture; diaphragmatic hernia	3	[12,50,51]
Cardiac/Valvular	Aortic valve rupture; prosthetic valve injury	2	[10,48]
Functional / Nonstructural	Vomiting	1	[38]
Mesenteric	Mesenteric laceration/hemorrhage	1	[52]

*Rib fractures were referenced in multiple studies but not reported as primary case outcomes, such as [9,11,13,19,20,22,26-29,31,32,39,43,47].

Table 5: Reported delayed presentations following the Heimlich maneuver. Summary of reported cases of delayed clinical presentation following the Heimlich maneuver, including the associated complication, estimated time to presentation, and presenting symptoms described in the literature.

Studies Delay	Complication Symptoms	Appro ximate	Presenting
LEE, 2009 [33]	Pancreatic pseudocyst	4 weeks	Abdominal pain
HAYNES, 1984 [14]	Esophageal rupture	Hours–days	Chest pain, dyspnea
BASILE, 2023 [17]	Esophageal perforation	Delayed	Dysphagia, vomiting
FINK, 1989 [9]	Pneumomediastinum	Delayed	Chest discomfort
OLENCHOCK, 2004 [37]	Emphysema	Delayed	Respiratory symptoms

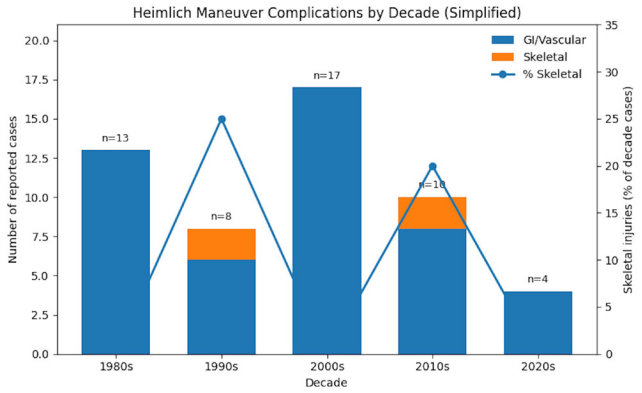

Figure 2: Reported heimlich maneuver-associated complications by decade. Distribution of reported Heimlich maneuver–associated complications across decades, categorized as gastrointestinal/ vascular, skeletal, and other injuries. Bars represent the total number of reported complications per decade, while the overlaid line shows the proportion of skeletal injuries among all reported complications in each period. Gastrointestinal and vascular complications remained consistently represented across decades and accounted for most reported injuries. In contrast, skeletal complications were reported sporadically without a clear temporal increase despite increasing overall publication of Heimlich maneuver complications, suggesting potential under recognition or underreporting of musculoskeletal injuries in the literature. The total number of reported complications for each decade is displayed above the corresponding bars.

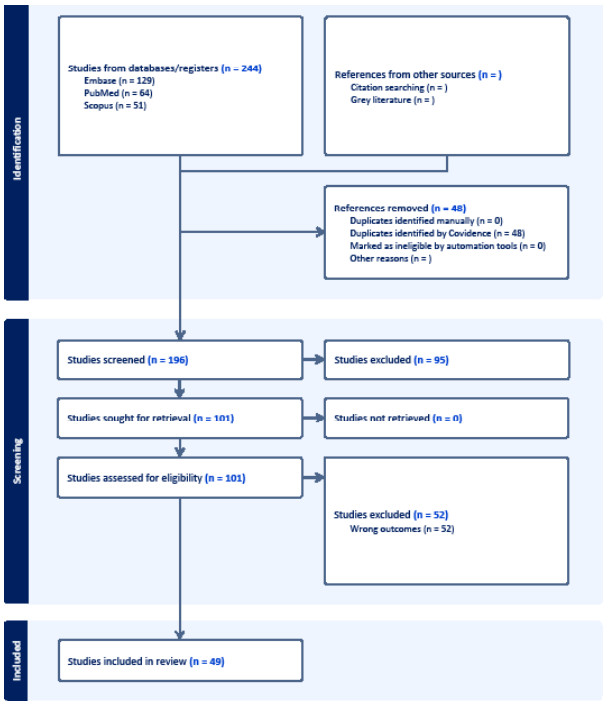

Figure 1: PRISMA flow diagram of study selection.
PRISMA flow diagram illustrating the identification, screening, eligibility assessment, and inclusion of studies reporting complications associated with the Heimlich maneuver. A total of 244 records were identified through database searching (EMBASE, PubMed, and Scopus). After removing 48 duplicate records using Covidence, 196 studies underwent title and abstract screening. Of these, 95 studies were excluded, and 101 full-text articles were assessed for eligibility. Following full-text review, 52 studies were excluded for not reporting relevant complication outcomes, leaving 49 included in the final qualitative synthesis.

PRISMA-S CHECKLIST

Literature and information being sought: This systematic review evaluates reported complications associated with the Heimlich maneuver or abdominal thrusts for Foreign Body Airway Obstruction (FBAO), with a focus on categorizing injuries by organ system, describing patient outcomes, and identifying reporting gaps or potential publication bias in the published literature.

Databases and interfaces searched:

Database	Interface	Date coverage	Date searched
MEDLINE/PubMed	PubMed	1948 to present	31 January 2026
Scopus	Scopus	1788 to present	31 January 2026
EMBASE via Embase.com	Embase.com / Elsevier EMBASE	1974 to present	31 January 2026

Simultaneous searches: N/A.

Item 2: Other online resources (As needed): N/A.

Manual Searching (searching relevant journals' Table of Contents): N/A.

Citation searching and text analysis: Reference lists of included studies and relevant review articles were manually screened to identify additional eligible reports not captured in the primary database search. No separate citation-search record count was recorded; all final included studies were reconciled in Covidence.

Process: Searches were performed using keywords and database-controlled vocabulary related to the Heimlich maneuver, abdominal thrusts, FBAO, and reported injuries/complications. Search results were imported into Covidence for duplicate removal, title/abstract screening, full-text review, and data extraction by two reviewers, with disagreements resolved by consensus.

Contacts (Researchers contacted for additional information): N/A.

Additional methodologies not listed above: N/A.

Limits and restrictions

Date and time period: Inception - 31 January 2026.

Language: English.

Publication status: Published/Peer Reviewed.

Species included: Human subjects.

Study design: Case reports, case series, and observational studies reporting original patient data.

Database subset: N/A.

Pre-specified cut-off or saturation point for results: N/A.

Other restrictions: N/A.

Search filters:

MEDLINE/PubMed	PubMed	English; human subjects; original case reports, case series, or observational studies when identifiable
Scopus	Scopus	English; journal articles; original patient data when identifiable
EMBASE	Embase.com / Elsevier EMBASE	English; human subjects; journal articles; original patient data when identifiable

Full search strategy

Search database: PubMed.

Search ID	Terms (copy and paste)	Results
#1	(("Heimlich Maneuver"[Title/Abstract] OR "abdominal thrust*"[Title/Abstract]) AND ("complication*"[Title/Abstract] OR "injury*"[Title/Abstract] OR "trauma*"[Title/Abstract] OR "rupture*"[Title/Abstract] OR "perforation*"[Title/Abstract] OR "fracture*"[Title/Abstract] OR "pneumomediastinum"[Title/Abstract] OR "pneumothorax"[Title/Abstract]))	70
#5	#1 AND English [Language] AND Human[species]	64
Copy and paste:	(("Heimlich Maneuver"[Title/Abstract] OR "abdominal thrust*"[Title/Abstract]) AND ("complication*"[Title/Abstract] OR "injury*"[Title/Abstract] OR "trauma*"[Title/Abstract] OR "rupture*"[Title/Abstract] OR "perforation*"[Title/Abstract] OR "fracture*"[Title/Abstract] OR "pneumomediastinum"[Title/Abstract] OR "pneumothorax"[Title/Abstract])) AND (English [Filter])	64

Search database: Scopus.

Search ID	Terms (copy and paste)	Results
#1	TITLE-ABS-KEY ("Heimlich maneuver" OR Heimlich OR "Abdominal thrust" OR "abdominal thrusts" OR "foreign body airway obstruction" OR FBAO)	864
#2	TITLE-ABS-KEY (complication* OR injury* OR trauma OR rupture OR perforation OR laceration OR fracture* OR pneumothorax OR pneumomediastinum OR emphysema)	513
#3	TITLE-ABS-KEY (aortic OR vascular OR gastric OR esophageal OR esophageal OR jejunal OR splenic OR hepatic OR pancreatic OR diaphragmatic OR mesenteric OR rib OR sternal OR vertebral OR osteoporosis)	158
#5	#3 AND LIMIT-TO (LANGUAGE, "English") AND (KEYWORD, "Human") AND (SUBJECT AREA, "Medicine") AND (DOCUMENT TYPE, "Article").	51
#6	Targeted skeletal search: #1 AND TITLE-ABS-KEY (rib OR fracture* OR sternal OR vertebral OR osteoporosis) AND LIMIT-TO (LANGUAGE, "English")	Included within Scopus total
Copy and paste:	TITLE-ABS-KEY ("Heimlich maneuver" OR Heimlich OR "Abdominal thrust" OR "abdominal thrusts" OR "foreign body airway obstruction" OR FBAO) AND TITLE-ABSKEY (complication* OR injury* OR trauma OR rupture OR perforation OR laceration OR fracture* OR pneumothorax OR pneumomediastinum OR emphysema OR aortic OR vascular OR gastric OR esophageal OR esophageal OR jejunal OR splenic OR hepatic OR pancreatic OR diaphragmatic OR mesenteric OR rib OR sternal OR vertebral OR osteoporosis) AND LIMITTO (LANGUAGE, "English")	51

Search database: EMBASE.

Search ID	Terms (copy and paste)	Results
#1	'heimlich maneuver'/exp OR 'heimlich maneuver':ti,ab OR heimlich:ti,ab OR 'abdominal thrust':ti,ab OR 'abdominal thrusts':ti,ab OR 'foreign body airway obstruction':ti,ab OR fbao:ti,ab	913
#2	#1 AND (complication*:ti,ab OR injur*:ti,ab OR trauma:ti,ab OR rupture:ti,ab OR perforation:ti,ab OR laceration:ti,ab OR fracture*:ti,ab)	309
#3	#1 AND (aortic:ti,ab OR vascular:ti,ab OR gastric:ti,ab OR esophageal:ti,ab OR oesophageal:ti,ab OR jejunal:ti,ab OR splenic:ti,ab OR hepatic:ti,ab OR pancreatic:ti,ab OR diaphragmatic:ti,ab OR mesenteric:ti,ab OR rib:ti,ab OR sternal:ti,ab OR vertebral:ti,ab OR osteoporosis:ti,ab)	115
#4	#2 OR #3	341
#5	#4 AND [english] AND [human subject]	300
#6	#5 AND [article]	129
#7	Copy and paste: ('heimlich maneuver'/exp OR 'heimlich maneuver':ti,ab OR heimlich:ti,ab OR 'abdominal thrust':ti,ab OR 'abdominal thrusts':ti,ab OR 'foreign body airway obstruction':ti,ab OR fbao:ti,ab) AND ((complication*:ti,ab OR injur*:ti,ab OR trauma:ti,ab OR rupture:ti,ab OR perforation:ti,ab OR laceration:ti,ab OR fracture*:ti,ab) OR (aortic:ti,ab OR vascular:ti,ab OR gastric:ti,ab OR esophageal:ti,ab OR oesophageal:ti,ab OR jejunal:ti,ab OR splenic:ti,ab OR hepatic:ti,ab OR pancreatic:ti,ab OR diaphragmatic:ti,ab OR mesenteric:ti,ab OR rib:ti,ab OR sternal:ti,ab OR vertebral:ti,ab OR osteoporosis:ti,ab)) AND ((english):la) AND (('human')/br) AND ((article):it)	129

Results

Database records identified: EMBASE (n=129), PubMed/MEDLINE (n=64), and Scopus (n=51), for a total of 244 records. Covidence removed 48 duplicate records, leaving 196 records for title/abstract screening. Ninety-five records were excluded during title/abstract screening, and 101 reports were sought and assessed for eligibility. No reports were unavailable for retrieval. Fifty-two full-text reports were excluded for wrong outcomes or insufficient relevance to Heimlich maneuver-associated complications. Forty-nine studies were included in the final review.

Total Records	Total records after deduplication	Deduplication software/methodology
244	196	Covidence; 48 duplicate records removed automatically during import/deduplication

Search designers: The search strategy was developed by the review team and content expert, then translated across PubMed, Scopus, and EMBASE. All records were imported into Covidence systematic review software (Veritas Health Innovation, Melbourne, Australia) for deduplication and screening.

Discussion

This systematic review summarizes reported complications associated with the Heimlich maneuver and highlights potential biases in the published literature regarding the recognition and reporting of complications. By integrating findings from case reports and imaging studies, this review aimed to characterize the spectrum of injuries associated with abdominal thrusts and identify factors associated with adverse outcomes.

The reviewed literature demonstrated substantial heterogeneity in post-maneuver complications, involving multiple organ systems and ranging from minor pressure-related injuries to serious vascular and gastrointestinal rupture. The observed injuries may result from rapid transmission of force through the thoracoabdominal cavity, producing sudden increases in intraluminal, intrathoracic, and vascular pressures. Structures with pre-existing weakness, including atherosclerotic vessels or previously injured skeletal structures, may therefore be particularly susceptible to injury. Gastrointestinal and vascular injuries were the most frequently reported complications, whereas skeletal injuries were reported relatively infrequently despite being commonly cited as a recognized risk of the maneuver. Across decades, gastrointestinal and vascular complications remained consistently represented, while skeletal injuries were reported sporadically and without a clear temporal increase, even in more recent years when advanced imaging modalities became widely available. Given the significant thoracoabdominal forces generated during abdominal thrusts, this discrepancy may reflect under recognition or underreporting of skeletal injuries rather than true rarity. Supporting this possibility, several studies have reported imaging findings suggestive of skeletal injury without definitive confirmation of fracture.

Pediatric patients are particularly at risk for FBAO, making familiarity with the Heimlich maneuver an essential component of caregiver education and basic life support training. However, the reviewed cases also emphasize that understanding when to perform the maneuver is equally important as understanding how to perform it correctly. Several pediatric complications occurred in situations where abdominal thrusts were applied despite the absence of confirmed FBAO, resulting in severe and potentially preventable injuries. These findings highlight the importance of public education regarding proper indications, technique, and post-event evaluation following abdominal thrusts. In addition, one report documented a musculoskeletal injury sustained by the rescuer performing the maneuver, suggesting that improper technique may also place rescuers at risk.

Several clinical patterns associated with mortality were identified. Fatal outcomes were disproportionately associated with advanced age and aortic complications, suggesting that frailty and underlying vascular disease may increase susceptibility to significant injury. Patients requiring additional resuscitative interventions such as CPR, ventilation, or intubation also demonstrated higher mortality rates. However, this finding likely reflects greater underlying severity of the choking event and physiologic compromise rather than a harmful effect of the interventions themselves. Pre-existing comorbidities, particularly cardiovascular disease and atherosclerotic vascular pathology, were also frequently observed among patients with fatal vascular complications. These findings suggest that patient-specific factors, including age, medical history, and overall severity of presentation, may substantially influence outcomes following the Heimlich maneuver.

An additional important observation was the delayed presentation of several injuries. Multiple patients with gastrointestinal or thoracic complications initially appeared stable and later presented hours to days after the maneuver with symptoms such as chest pain, dyspnea, vomiting, dysphagia, or abdominal pain. This delayed clinical presentation underscores the importance of maintaining suspicion for occult injury in symptomatic patients following abdominal thrusts, particularly in older adults or patients with persistent symptoms.

This review is subject to limitations inherent to case-based literature. Publication bias likely favors the reporting of rare, severe, or unusual complications, while minor or self-limited injuries may remain underreported. Variability in terminology, inconsistent clinical documentation, and incomplete reporting of patient history, rescuer training, and concurrent resuscitative measures also limited analysis. Additionally, causal attribution remains challenging in cases involving multiple simultaneous interventions, such as combined abdominal thrusts and CPR. Given the rarity and heterogeneity of reported complications, findings should be interpreted cautiously and may not reflect the true incidence of injury associated with the Heimlich maneuver. Despite these limitations, this review provides one of the most comprehensive syntheses of reported Heimlich maneuver-associated complications across organ systems and age groups.

Although Heimlich maneuver-associated complications appear uncommon, the reported injuries demonstrate that abdominal thrusts may occasionally result in severe gastrointestinal, vascular, thoracic, or musculoskeletal trauma. Clinicians should maintain suspicion for occult injury in symptomatic patients following abdominal thrusts, particularly among older adults and patients with underlying cardiovascular or structural disease. Delayed presentation observed in several reports further supports the importance of careful post-event clinical assessment.

Conclusion

The Heimlich maneuver remains a life-saving intervention for foreign body airway obstruction; however, this review demonstrates that associated complications, although rare, may involve multiple organ systems and occasionally result in severe morbidity or mortality. Gastrointestinal and vascular injuries represented the most frequently reported complications and accounted for many fatal outcomes, particularly among older adults with underlying comorbidities. Delayed clinical presentation was observed in several cases, emphasizing the importance of continued clinical vigilance following abdominal thrusts.

This review also identified important gaps within the existing literature, including inconsistent reporting of patient characteristics, rescuer training status, concurrent resuscitative interventions, and injury confirmation. Skeletal and musculoskeletal injuries appeared underrepresented despite the substantial mechanical forces generated during the maneuver, suggesting possible under recognition or publication bias.

By synthesizing the available evidence, this study provides a more comprehensive characterization of Heimlich maneuver–associated complications across age groups and organ systems. Greater awareness among clinicians, caregivers, and first responders may improve recognition of post-maneuver injuries and reinforce the importance of proper training and appropriate application of abdominal thrusts. Future studies using standardized reporting and prospective data collection are needed to better define injury patterns, high-risk populations, and the true incidence of complications associated with the Heimlich maneuver.

Declarations

Author contributions: All listed authors made substantial contributions to the following: (i) the conception and design of the study, the acquisition of data, or the analysis and interpretation of data; (ii) drafting the article or critically revising its important intellectual content; (iii) final approval of the version submitted. All authors have agreed on the final version of this study.

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Ethical statement: Ethics approval and informed consent were not required because this study used previously published data.

Abbreviations: BVM: Bag-valve-mask; CPR: Cardiopulmonary resuscitation; EMBASE: Excerpta; Medica Database; FBAO: Foreign body airway obstruction; GI: Gastrointestinal; MESH - Medical; Subject Headings; PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses; PRISMA-S: Preferred Reporting Items for Systematic Reviews and Meta-Analyses Literature Search Extension.

Distribution of reported Heimlich maneuver–associated complications across decades, categorized as gastrointestinal/vascular, skeletal, and other injuries. Bars represent the total number of reported complications per decade, while the overlaid line shows the proportion of skeletal injuries among all reported complications in each period. Gastrointestinal and vascular complications remained consistently represented across decades and accounted for most reported injuries. In contrast, skeletal complications were reported sporadically without a clear temporal increase despite increasing overall publication of Heimlich maneuver complications, suggesting potential under recognition or underreporting of musculoskeletal injuries in the literature. The total number of reported complications for each decade is displayed above the corresponding bars.

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