Incidence of Acquired Dysphagia in Post-Cardiac Surgery Patients: A Systematic Review and Meta-Analysis Postprint

Authors: Liu Lu, Jiang Yunlan, Peng Hanmei, Lu Yutong, Liu Mingting, Liao Shiqin

Date: 2022-08-23T00:00:00+00:00

Abstract

Objective: To synthesize existing evidence and analyze the incidence of acquired dysphagia in patients after cardiac surgery.

Methods: Computerized searches were conducted in Chinese and English databases or search engines including CNKI, CBM, VIP, WanFang, PubMed, EMbase, The Cochrane Library, CINAHL, and Web of Science to identify clinical studies on the incidence of acquired dysphagia in patients after cardiac surgery. The study outcome was the occurrence of acquired dysphagia, and the search timeframe was from database inception to May 2022. Two researchers independently performed literature screening, quality assessment, and data extraction. Meta-analysis of incidence rates was conducted using Stata 15.0.

Results: A total of 15 articles were included, comprising 7880 patients. Meta-analysis results showed that the overall incidence of dysphagia in patients after cardiac surgery was 13.3% [95%CI (10.1%, 16.5%)]. Subgroup analysis results indicated that the incidence of acquired dysphagia in post-cardiac surgery patients was [16.6% (10.4%, 22.8%)] in Asia and [10.0% (6.1%, 13.8%)] in North America; there was no statistically significant difference in incidence between males [16.9% (11.8%, 21.9%)] and females [16.4% (11.1%, 21.8%)] (^{2}=1.843, P>0.05). The incidence of dysphagia in post-cardiac surgery patients under 70 years old and over 70 years old was [10.9% (8.6%, 13.5%)] and [28.4% (19.7%, 37.9%)], respectively. The incidence in patients with American New York Heart Association classification (NYHA) grades I-II and grades III-IV was [11.8% (7.4%, 16.3%)] and [21.0% (11.0%, 30.9%)], respectively. The incidence rates for perioperative endotracheal intubation times of less than 12h, 12-24h, 25-48h, and more than 48h were [1.0% (0.3%, 1.8%)], [6.4% (4.4%, 8.3%)], [16.8% (9.5%, 24.1%)], and [55.0% (28.0%, 82.0%)], respectively. Additionally, patients with chronic kidney disease, chronic lung disease, preoperative history of cerebrovascular accident,

atrial fibrillation, heart failure, intraoperative use of transesophageal echocardiography (TEE), perioperative stroke, and perioperative sepsis had higher incidence of acquired dysphagia after cardiac surgery.

Conclusion: Current evidence indicates that the incidence of acquired dysphagia in patients after cardiac surgery is relatively high, necessitating early screening and effective management of postoperative patients.

Full Text

The Incidence of Acquired Dysphagia after Cardiac Surgery: A Systematic Review and Meta-analysis

Authors: Liu Lu[1], Jiang Yunlan[2], *Peng Hanmei*[1], *Lu Yutong*[1], *Liu Mingting*[1], *Liao Shiqin*[1]

Affiliations:

1. School of Nursing, Chengdu University of Traditional Chinese Medicine, Chengdu 610072, Sichuan, China

2. The Affiliated Hospital of Chengdu University of Traditional Chinese Medicine, Chengdu 610075, Sichuan, China

Corresponding author: Jiang Yunlan, professor, master and doctoral supervisor; Email: 18980880152@163.com

Funding: National Key R&D Program of China, "Active Health and Aging Technology Response" Key Special Project (Project No.: 2020YFC2003104)

Abstract

Objective: To synthesize existing evidence and analyze the incidence of acquired dysphagia in patients after cardiac surgery.

Methods: We systematically searched Chinese and English databases including CNKI, CBM, VIP, WanFang, PubMed, EMbase, The Cochrane Library, CINAHL, and Web of Science for clinical studies reporting the incidence of acquired dysphagia following cardiac surgery. The search timeframe spanned from database inception to May 2022, with the primary outcome being the occurrence of acquired dysphagia. Two researchers independently conducted literature screening, quality assessment, and data extraction, with meta-analysis of incidence rates performed using Stata 15.0.

Results: Fifteen studies comprising 7,880 patients were included. Meta-analysis revealed an overall dysphagia incidence of 13.3% [95%CI (10.1%, 16.5%)] after cardiac surgery. Subgroup analyses showed incidence rates of 16.6% (10.4%, 22.8%) in Asia and 10.0% (6.1%, 13.8%) in North America. No significant sex difference was observed [male: 16.9% (11.8%, 21.9%); female: 16.4% (11.1%, 21.8%); ^{2}=1.843, P>0.05]. Patients under 70 years had an incidence of 10.9% (8.6%, 13.5%) compared to 28.4% (19.7%, 37.9%) in those aged 70 and above. For NYHA Class I-II versus III-IV patients, incidence

rates were 11.8% (7.4%, 16.3%) and 21.0% (11.0%, 30.9%), respectively. By perioperative intubation duration, incidence rates were 1.0% (0.3%, 1.8%) for $ $12h, 6.4% (4.4%, 8.3%) for 12-24h, 16.8% (9.5%, 24.1%) for 25-48h, and 55.0% (28.0%, 82.0%) for >48h. Additionally, higher incidence was associated with chronic kidney disease, chronic lung disease, preoperative cerebrovascular accident history, atrial fibrillation history, heart failure history, intraoperative transesophageal echocardiography (TEE) use, perioperative stroke, and perioperative sepsis.

Conclusion: Current evidence indicates a high incidence of acquired dysphagia after cardiac surgery, necessitating early screening and effective management for postoperative patients.

Keywords: Cardiac surgery; Dysphagia; Incidence; Meta-analysis

---

Dysphagia refers to impaired structural or functional integrity of organs including the jaw, lips, oral cavity, pharynx, and esophagus, resulting in inability to safely and effectively transport food or liquids into the stomach [1]. When caused by disease, treatment, or other iatrogenic factors, it is termed acquired dysphagia [2]. With advances in cardiac surgical techniques and changing modern lifestyles, both cardiovascular disease patients and complex cardiac procedures have increased, highlighting postoperative acquired dysphagia as a serious complication [3]. This condition can lead to malnutrition, aspiration, pneumonia [4,5], and psychological symptoms such as social isolation and depression due to inability to eat orally or prolonged nasogastric tube placement [6], ultimately reducing quality of life and increasing in-hospital mortality [7,8]. Current studies report widely varying incidence rates from 3% to 51% [3,9,10], likely due to differences in study populations and designs. This meta-analysis aims to analyze the incidence of acquired dysphagia after cardiac surgery to provide evidence for clinical screening and prevention. This study is registered with PROSPERO (registration number: CRD42022336151).

1.1 Data Sources and Search Strategy

We systematically searched PubMed, EMbase, The Cochrane Library, CINAHL, Web of Science, CBM, CNKI, WanFang, and VIP databases using a combination of subject headings and free-text terms. Chinese search terms included "心脏手术/心脏术后/冠状动脉旁路移植术/冠状动脉搭桥术/心脏瓣膜手术/瓣膜置换术/二尖瓣手术/主动脉瓣手术/瓣膜病," "吞咽困难/吞咽障碍/吞咽功能障碍/吞咽功能减退/吞咽功能受损," and "发病率/流行病学." English search terms included "Cardiac surgery/heart surgery/coronary artery bypass grafting/CABG/valv* surgery/valv* replacement," "dysphagia/deglutition dysfunction/deglutition impairment/deglutition decline/deglutition disorder/*swallowing disorder*/impaired swallowing," and "prevalence/*epidemi*/incidence*."The search covered publications from database inception to May 2022, with additional studies identified through citation tracking. The specific PubMed search strategy is shown in Table 1 .

1.2.1 Inclusion Criteria

(1) **Study population:** Patients aged $ $18 years undergoing cardiac surgery without preoperative dysphagia; (2) **Study design:** Observational studies including cohort, case-control, and cross-sectional studies; (3) **Outcome:** Studies reporting the incidence of acquired dysphagia after cardiac surgery.

1.2.2 Exclusion Criteria

(1) Duplicate publications or studies with identical raw data; (2) Studies with incomplete data or inability to extract analyzable information; (3) Studies published in languages other than Chinese or English; (4) Conference abstracts, reviews, and case reports.

1.3 Literature Screening and Data Extraction

Two trained researchers independently performed literature screening and data extraction according to the inclusion and exclusion criteria, with results cross-checked. Disagreements were resolved through consultation with a third researcher. Extracted data included basic study information, sample size, assessment tools, surgical procedures, study design, and risk factors.

1.4 Literature Quality Assessment

Two researchers independently assessed study quality. Cross-sectional studies were evaluated using the Agency for Healthcare Research and Quality (AHRQ) tool [11], comprising 11 items scored as 1 point for "yes" and 0 for "no" or "unclear," with total scores of 8-11 indicating high quality, 4-7 moderate quality, and 0-3 low quality. Cohort and case-control studies were assessed using the Newcastle-Ottawa Scale (NOS) [12], which includes 8 items totaling 9 points across three domains: study group selection (0-4 points), comparability (0-2 points), and exposure measurement (0-3 points), with scores of 7-9 indicating high quality, 5-6 moderate quality, and 0-4 low quality.

1.5 Statistical Analysis

We used Stata 15.0 for statistical analysis, with incidence of acquired dysphagia as the effect measure and 95% confidence intervals calculated. Heterogeneity was assessed using I^2 and Q tests. When P>0.1 and I^2<50%, indicating low heterogeneity, a fixed-effects model was used; when P$ $0.1 and I^{\{2\}\$\$\ 50}\{2\}\$$ tests [13] to examine differences between subgroups, with P<0.05 considered statistically significant.

2.1 Literature Search Results

The initial search yielded 1,561 potentially relevant articles, with 3 additional studies identified through reference screening. After removing 314 duplicates

using NoteExpress and manual checking, 1,184 articles were excluded based on title and abstract review. The remaining 66 articles underwent full-text assessment, resulting in 15 studies [3,9,10,14-25] meeting inclusion criteria (5 Chinese, 10 English). The literature screening flowchart is shown in Figure 1 [Figure 1: see original paper].

2.2 Basic Characteristics and Quality Assessment of Included Studies

The 15 included studies comprised 7,880 patients, with 742 developing acquired dysphagia after cardiac surgery. Quality assessment identified all studies as moderate-to-high quality. Basic characteristics and quality ratings are summarized in Table 2 .

2.3.1 Overall Incidence

Heterogeneity testing of the 15 included studies revealed substantial heterogeneity (I^2=97.2%, P<0.0001), warranting use of a random-effects model. The pooled incidence of dysphagia after cardiac surgery was 13.3% [95%CI (10.1%, 16.5%)], as shown in Figure 2 [Figure 2: see original paper].

2.3.2 Subgroup Analysis

Subgroup analyses by region showed incidence rates of 16.6% (10.4%, 22.8%) in Asia, 10.0% (6.1%, 13.8%) in North America, and 17.4% (12.3%, 23.5%) in Oceania. No significant sex difference was observed [male: 16.9% (11.8%, 21.9%); female: 16.4% (11.1%, 21.8%); ^{2}=1.843, P>0.05]. Patients aged <70 years had an incidence of 10.9% (8.6%, 13.5%) compared to 28.4% (19.7%, 37.9%) in those $ $70 years. By NYHA class, incidence rates were 11.8% (7.4%, 16.3%) for Class I-II and 21.0% (11.0%, 30.9%) for Class III-IV. By intubation duration, incidence rates were 1.0% (0.3%, 1.8%) for $ $12h, 6.4% (4.4%, 8.3%) for 12-24h, 16.8% (9.5%, 24.1%) for 25-48h, and 55.0% (28.0%, 82.0%) for >48h. Higher incidence was also associated with chronic kidney disease, chronic lung disease, preoperative cerebrovascular accident history, atrial fibrillation history, heart failure history, intraoperative TEE use, perioperative stroke, and perioperative sepsis. Heterogeneity analysis indicated that intubation duration accounted for the largest reduction in heterogeneity, suggesting it is a major source of between-study variation. Results are detailed in Table 3 .

2.3.3 Sensitivity Analysis

Leave-one-out sensitivity analysis showed that the pooled effect size remained within its 95% confidence interval for all iterations, indicating robust meta-analysis results. The greatest change in effect size occurred when excluding Barker' s study [9], suggesting it contributed substantially to heterogeneity. The sensitivity analysis plot is shown in Figure 3 [Figure 3: see original paper].

2.3.4 Publication Bias Assessment

Begg' s and Egger' s tests both indicated significant publication bias ($p<0.05$). Trim-and-fill analysis of the asymmetric funnel plot suggested that seven additional studies with results similar to Zhou Meng [20], Ye Lan [18], Cheng Hongping [16], Barker [9], Grimm [22], Daly [21], and Zhou [14] would be needed to achieve funnel plot symmetry. The funnel plot is shown in Figure 4 [Figure 4: see original paper].

3 Discussion

Dysphagia is a clinical syndrome characterized by impaired transport of food from the oral cavity to the stomach, commonly occurring after stroke or certain neuromuscular diseases [26]. In recent years, it has emerged as a serious complication following cardiac surgery, with mechanisms not yet fully elucidated but thought to relate to surgical invasiveness, artificial airway establishment, and anesthesia-related irritation [19,23]. Postoperative dysphagia can cause aspiration pneumonia, malnutrition, dehydration, reduced quality of life, and increased mortality risk [27].

Our meta-analysis found a 13.3% overall incidence of dysphagia after cardiac surgery, consistent with Skoretz et al.' s systematic review reporting 3-62% incidence of dysphagia after extubation [5] but lower than Wan et al.' s reported 15.5-64.1% incidence in ICU patients [28]. This discrepancy likely reflects that ICU patients are generally more critically ill, with prolonged intubation and higher complication risks, as disease severity correlates significantly with acquired dysphagia [29]. The substantial incidence underscores the need for early dysphagia screening and interventions including dietary modifications, environmental adjustments, positioning strategies, and swallowing training to improve patient outcomes.

Significant heterogeneity was observed ($I^2=97.2\%$, $P<0.0001$). Sensitivity analysis identified Barker's study [9] as the greatest contributor to effect size variation, possibly due to its small sample size and inclusion of only patients with intubation $ $48h. Subgroup analysis confirmed intubation duration as the primary heterogeneity source, though variations in assessment tools, surgical procedures, and study designs may also contribute.

Regional subgroup analysis revealed higher incidence in Asia than North America, possibly reflecting differences in economic and healthcare levels, ethnic characteristics, and medical practices. The single Oceania study limits representativeness. No sex difference was observed, consistent with most studies indicating gender is not a risk factor [23,30]. Patients $ $70 years showed markedly higher incidence, likely due to age-related declines in swallowing muscle strength, sensory perception, and compensatory capacity, exacerbated by artificial airway and disease-related stress [31].

Dysphagia incidence increased progressively with intubation duration, reaching

55% when >48h. Bordon et al. found each additional intubation day increased dysphagia risk by 14% [32], while Kwok et al. reported dysphagia incidence increased 25% daily, reaching 50% after two days [33]. Artificial airways disrupt normal swallowing physiology through: (1) direct mechanical compression causing tissue injury and mucosal edema; (2) disuse atrophy of oropharyngeal muscles; and (3) anesthetic and sedative effects on central and peripheral nervous systems reducing sensory and motor responses [20].

Higher NYHA class (≥III), preoperative atrial fibrillation, and heart failure history were associated with increased dysphagia risk, possibly due to reduced perfusion affecting oropharyngeal function [34] and preoperative frailty increasing complication risk [4]. Preoperative cerebrovascular accidents and perioperative stroke likely impair neural control of swallowing [35]. Chronic lung disease increased risk, potentially through reduced laryngeal sensitivity, impaired respiratory-swallow coordination, and altered intrathoracic pressure [36]. Chronic kidney disease was also associated with higher incidence, with Pinto et al. demonstrating abnormal swallowing patterns in these patients [37], possibly related to xerostomia and uremic neurotoxicity.

Intraoperative TEE use increased dysphagia risk, likely due to tissue trauma, excessive manipulation, thermal injury, and mechanical compression [38]. Perioperative sepsis was associated with higher incidence, as sepsis and systemic inflammatory response syndrome are major risk factors for critical illness polyneuropathy and myopathy [39], with approximately 70% of severe sepsis patients developing peripheral neuropathy [40], potentially impairing the complex sensorimotor coordination required for swallowing.

This study has several limitations: (1) inherent limitations of single-rate meta-analysis and between-study differences in intubation duration, sample sizes, assessment tools, and surgery types contributed to substantial heterogeneity; (2) limited number of included studies with uneven geographic distribution may affect result accuracy; (3) some subgroups included few studies, limiting generalizability; (4) study design limitations make various biases unavoidable, potentially affecting reliability.

In conclusion, acquired dysphagia after cardiac surgery is common, influenced by geographic region, age, cardiac function, intubation duration, and multiple preoperative and perioperative comorbidities, leading to adverse outcomes requiring early screening and intervention. More high-quality, multicenter, large-sample studies are needed to further characterize this condition.

Author Contributions: Liu Lu conceptualized and designed the study, drafted and revised the manuscript, and takes overall responsibility. Jiang Yunlan revised the manuscript and provided quality control and final approval. Peng Hanmei and Lu Yutong conducted literature searches and data compilation. Liu Lu, Liu Mingting, and Liao Shiqin performed statistical analysis and interpreted results.

Conflict of Interest: The authors declare no conflicts of interest.

References:

Note: Figure translations are in progress. See original paper for figures.