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FOREIGN BODY AIRWAY OBSTRUCTION: A SYSTEMATIC REVIEW

OBSTRUÇÃO DAS VIAS AÉREAS POR CORPO ESTRANHO: UMA REVISÃO SISTEMÁTICA

OBSTRUCCIÓN DE LAS VÍAS RESPIRATORIAS POR CUERPO EXTRAÑO: UNA REVISIÓN SISTEMÁTICA

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ABSTRACT

Introduction: Foreign body airway obstruction is a time-critical clinical emergency associated with preventable morbidity and mortality across pediatric and adult populations. Although the highest burden remains concentrated in children, recent evidence shows that clinically important events also occur in older adults, hospitalized patients, and individuals with neurological or swallowing impairment. The available literature has expanded in recent years, but it remains methodologically heterogeneous and multidisciplinary in scope.

Objective: The main objective of this systematic review was to synthesize contemporary evidence on foreign body airway obstruction with emphasis on epidemiology, clinical recognition, diagnosis, intervention, and outcomes. Secondary objectives were to compare age-related risk profiles, assess the diagnostic contribution of history, examination, imaging, and endoscopy, evaluate the effectiveness of initial airway clearance maneuvers and bronchoscopic interventions, analyze the evolving roles of rigid and flexible bronchoscopy, and identify major evidence gaps relevant to clinical practice and future research.

Methods: A systematic search was performed in PubMed, Scopus, Web of Science, Cochrane Library, LILACS, ClinicalTrials.gov, and ICTRP. Studies published within the last five years were prioritized, with protocol allowance for expansion to ten years if necessary. Eligible designs included randomized and nonrandomized studies, observational cohorts, diagnostic studies, registry analyses, and clinically informative case series. Study selection and data extraction were conducted independently by reviewers according to PRISMA principles. Risk of bias was assessed with RoB 2, ROBINS-I, and QUADAS-2 as appropriate, and certainty of evidence was judged using GRADE.

Results and Discussion: Twenty studies were included in the final review. The evidence consistently showed that delayed diagnosis was associated with higher morbidity, more

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complex procedures, and greater pulmonary complication risk. Rigid bronchoscopy remained the principal definitive intervention in most confirmed pediatric cases, while recent data supported an expanding but selective role for flexible bronchoscopy in experienced centers and favorable anatomical contexts. Diagnostic scores such as FOBAS demonstrated promising accuracy in children, but no isolated clinical or radiographic feature reliably excluded aspiration. Recent population-based studies also suggested that bystander basic life support interventions were associated with improved obstruction relief and better survival-related outcomes.

Conclusion: Contemporary evidence supports a multidisciplinary and individualized approach to foreign body airway obstruction that integrates rapid recognition, prompt first-aid response, low threshold for bronchoscopy in high-suspicion cases, and context-sensitive procedural planning. The strongest recurring messages across the literature are the clinical importance of avoiding diagnostic delay and the need to align management with patient age, airway location, foreign body characteristics, and local expertise. Higher-quality prospective multicenter studies are still needed to improve certainty in diagnostic and comparative effectiveness questions.

Keywords: Airway Obstruction. Foreign Bodies. Bronchoscopy. Respiratory Aspiration.

RESUMO

Introdução: A obstrução das vias aéreas por corpo estranho é uma emergência clínica tempo-dependente associada à morbidade e mortalidade evitáveis em populações pediátricas e adultas. Embora a maior carga permaneça concentrada em crianças, evidências recentes mostram que eventos clinicamente relevantes também ocorrem em idosos, pacientes hospitalizados e indivíduos com comprometimento neurológico ou de deglutição. A literatura disponível tem se expandido nos últimos anos, mas permanece metodologicamente heterogênea e de caráter multidisciplinar.

Objetivo: O objetivo principal desta revisão sistemática foi sintetizar evidências contemporâneas sobre obstrução das vias aéreas por corpo estranho, com ênfase em epidemiologia, reconhecimento clínico, diagnóstico, intervenção e desfechos. Os objetivos secundários foram comparar perfis de risco relacionados à idade, avaliar a contribuição diagnóstica da história clínica, exame físico, exames de imagem e endoscopia, analisar a eficácia das manobras iniciais de desobstrução das vias aéreas e das intervenções broncoscópicas, examinar os papéis em evolução da broncoscopia rígida e flexível e identificar lacunas relevantes na evidência para a prática clínica e futuras pesquisas.

Métodos: Foi realizada uma busca sistemática nas bases PubMed, Scopus, Web of Science, Cochrane Library, LILACS, ClinicalTrials.gov e ICTRP. Estudos publicados nos últimos cinco anos foram priorizados, com possibilidade de ampliação para dez anos, se necessário. Os desenhos elegíveis incluíram estudos randomizados e não randomizados, coortes observacionais, estudos diagnósticos, análises de registros e séries de casos clinicamente informativas. A seleção dos estudos e a extração dos dados foram conduzidas de forma independente por revisores, de acordo com os princípios do PRISMA. O risco de viés foi avaliado com RoB 2, ROBINS-I e QUADAS-2, conforme apropriado, e a certeza da evidência foi julgada pelo sistema GRADE.

Resultados e Discussão: Vinte estudos foram incluídos na revisão final. As evidências demonstraram consistentemente que o diagnóstico tardio esteve associado a maior morbidade, procedimentos mais complexos e maior risco de complicações pulmonares. A broncoscopia rígida permaneceu como a principal intervenção definitiva na maioria dos casos pediátricos confirmados, enquanto dados recentes apoiaram um papel crescente,

porém seletivo, da broncoscopia flexível em centros experientes e em contextos anatômicos favoráveis. Escores diagnósticos como o FOBAS demonstraram acurácia promissora em crianças, mas nenhuma característica clínica ou radiográfica isolada foi capaz de excluir de forma confiável a aspiração. Estudos populacionais recentes também sugeriram que intervenções de suporte básico de vida realizadas por testemunhas estiveram associadas à maior resolução da obstrução e a melhores desfechos relacionados à sobrevida.

Conclusão: Evidências contemporâneas apoiam uma abordagem multidisciplinar e individualizada para a obstrução das vias aéreas por corpo estranho, que integra reconhecimento rápido, resposta imediata de primeiros socorros, baixo limiar para broncoscopia em casos de alta suspeição e planejamento procedimental sensível ao contexto. As mensagens mais consistentes na literatura são a importância clínica de evitar atrasos diagnósticos e a necessidade de alinhar o manejo à idade do paciente, localização da via aérea, características do corpo estranho e expertise local. Estudos prospectivos multicêntricos de maior qualidade ainda são necessários para aumentar a certeza em questões diagnósticas e de efetividade comparativa.

Palavras-chave: Obstrução das Vias Aéreas. Corpos Estranhos. Broncoscopia. Aspiração Respiratória.

RESUMEN

Introducción: La obstrucción de las vías respiratorias por cuerpo extraño es una emergencia clínica tiempo-dependiente asociada con morbilidad y mortalidad prevenibles en poblaciones pediátricas y adultas. Aunque la mayor carga sigue concentrada en los niños, la evidencia reciente muestra que también ocurren eventos clínicamente relevantes en adultos mayores, pacientes hospitalizados e individuos con alteraciones neurológicas o de deglución. La literatura disponible ha crecido en los últimos años, pero sigue siendo metodológicamente heterogénea y de carácter multidisciplinario.

Objetivo: El objetivo principal de esta revisión sistemática fue sintetizar la evidencia contemporánea sobre la obstrucción de las vías respiratorias por cuerpo extraño, con énfasis en epidemiología, reconocimiento clínico, diagnóstico, intervención y resultados. Los objetivos secundarios fueron comparar perfiles de riesgo según la edad, evaluar la contribución diagnóstica de la historia clínica, el examen físico, las imágenes y la endoscopia, analizar la efectividad de las maniobras iniciales de desobstrucción y de las intervenciones broncoscópicas, examinar los roles en evolución de la broncoscopia rígida y flexible, e identificar vacíos de evidencia relevantes para la práctica clínica y futuras investigaciones.

Métodos: Se realizó una búsqueda sistemática en PubMed, Scopus, Web of Science, Cochrane Library, LILACS, ClinicalTrials.gov e ICTRP. Se priorizaron estudios publicados en los últimos cinco años, con posibilidad de ampliación hasta diez años si era necesario. Los diseños elegibles incluyeron estudios aleatorizados y no aleatorizados, cohortes observacionales, estudios diagnósticos, análisis de registros y series de casos clínicamente informativas. La selección de estudios y la extracción de datos se realizaron de forma independiente por revisores, de acuerdo con los principios PRISMA. El riesgo de sesgo se evaluó mediante RoB 2, ROBINS-I y QUADAS-2, según correspondiera, y la certeza de la evidencia se valoró con GRADE.

Resultados y Discusión: Se incluyeron veinte estudios en la revisión final. La evidencia mostró consistentemente que el diagnóstico tardío se asoció con mayor morbilidad, procedimientos más complejos y mayor riesgo de complicaciones pulmonares. La broncoscopia rígida se mantuvo como la principal intervención definitiva en la mayoría de los casos pediátricos confirmados, mientras que datos recientes respaldaron un papel creciente,

aunque selectivo, de la broncoscopia flexible en centros experimentados y en contextos anatómicos favorables. Puntuaciones diagnósticas como FOBAS mostraron una precisión prometedora en niños, pero ninguna característica clínica o radiográfica aislada excluyó de manera confiable la aspiración. Estudios poblacionales recientes también sugirieron que las intervenciones de soporte vital básico realizadas por testigos se asociaron con una mayor resolución de la obstrucción y mejores resultados relacionados con la supervivencia.

Conclusión: La evidencia contemporánea respalda un enfoque multidisciplinario e individualizado para la obstrucción de las vías respiratorias por cuerpo extraño, que integra reconocimiento rápido, respuesta inmediata de primeros auxilios, bajo umbral para broncoscopia en casos de alta sospecha y planificación procedimental sensible al contexto. Los mensajes más consistentes en la literatura son la importancia clínica de evitar retrasos diagnósticos y la necesidad de adaptar el manejo a la edad del paciente, la localización de la vía aérea, las características del cuerpo extraño y la experiencia local. Aún se necesitan estudios prospectivos multicéntricos de mayor calidad para mejorar la certeza en cuestiones diagnósticas y de efectividad comparativa.

Palabras clave: Obstrucción de las Vías Respiratorias. Cuerpos Extraños. Broncoscopia. Aspiración Respiratoria.

1 INTRODUCTION

Foreign body airway obstruction is an acute respiratory emergency that can rapidly progress from partial airflow limitation to complete asphyxia when recognition and intervention are delayed.[1] The condition remains clinically relevant across prehospital, emergency, inpatient, and critical care settings because deterioration may occur within minutes and because immediate treatment is often initiated by laypersons or first-contact professionals rather than airway specialists.[1] Contemporary resuscitation guidance therefore treats choking as a time-sensitive cause of potentially preventable death and emphasizes prompt identification of ineffective cough, progressive respiratory distress, and loss of consciousness.[1] The epidemiologic importance of foreign body airway obstruction is further reinforced by systematic evaluations showing that evidence-informed airway clearance maneuvers remain central to basic life support algorithms.[2]

Available recent evidence also shows that the literature on removal strategies is heterogeneous, with most data deriving from observational cohorts, registry analyses, case series, and low-certainty comparative studies rather than randomized trials.[2] This limitation is particularly important because the emergency nature of foreign body airway obstruction makes conventional trial design difficult, yet clinicians still need practical guidance regarding back blows, abdominal thrusts, chest thrusts, direct laryngoscopy, Magill forceps use, bronchoscopy, and rescue airway procedures.[2] Beyond the immediate event, retained airway foreign bodies may produce delayed morbidity through atelectasis, recurrent pneumonia, granulation tissue formation, bronchiectasis, and chronic cough, thereby broadening the clinical spectrum from dramatic collapse to indolent pulmonary disease.[3]

Recent bronchoscopic series including both children and adults confirm that foreign body aspiration is not restricted to a single age group, although the clinical context, type of aspirated material, and diagnostic delay differ substantially between pediatric and adult populations.[3] In children, aspiration events are more commonly linked to food particles and small objects during unsupervised eating or play, whereas in adults they are often associated with food bolus aspiration, impaired swallowing, neurological disease, sedation, alcohol use, or poor dentition.[3] These age-related differences have direct implications for prevention, clinical suspicion, and the choice of extraction technique, particularly when rigid and flexible bronchoscopy are compared across settings with different expertise and resources.[4]

Pediatric disease deserves special emphasis because young children remain disproportionately vulnerable due to immature chewing ability, exploratory behavior, and the small caliber of the airway.[4] Recent pediatric cohorts continue to show that choking history, sudden cough, unilateral wheeze, decreased breath sounds, and radiographic asymmetry

are among the most useful clues, although none alone is sufficiently reliable to exclude aspiration.[4] This diagnostic uncertainty explains why bronchoscopy is still frequently performed despite negative imaging when the clinical history is persuasive, especially in children with persistent symptoms after a witnessed choking episode.[4]

The burden of pediatric aspiration is also shaped by regional dietary habits and household practices, which influence both the type of foreign body and the anatomic level of obstruction.[5] Organic materials such as nuts and seeds predominate in many series and may provoke not only mechanical obstruction but also inflammatory mucosal injury when diagnosis is delayed.[5] Such observations are clinically meaningful because they help explain why some children present with acute respiratory compromise while others are initially misclassified as having viral wheeze, pneumonia, or asthma exacerbation.[5] More recent efforts to refine prediction through structured clinical tools have therefore sought to improve selection for bronchoscopy while minimizing unnecessary invasive procedures.[6]

Among these tools, recently studied aspiration scores highlight the enduring value of combining choking history, symptom pattern, physical examination, and imaging findings rather than relying on any isolated variable.[6] Although these models may improve stratification, they have not eliminated the central diagnostic challenge, namely that clinically important aspiration can still occur in patients with nondiagnostic radiographs and transient or subtle findings.[6] For that reason, modern management still depends heavily on sustained clinical suspicion, rapid reassessment, and low threshold for endoscopic evaluation when symptoms persist or when the history is strongly suggestive.[7]

The therapeutic dimension of foreign body airway obstruction has also evolved through recent registry-based and observational analyses of basic life support maneuvers.[7] These studies suggest that bystander action is strongly associated with relief of obstruction and improved survival, while at the same time underscoring how limited the comparative evidence remains for specific maneuver sequences in real-world emergencies.[7] The problem is especially important because intervention success may vary according to consciousness level, foreign body consistency, body habitus, age, and whether the obstruction is partial or complete at the time of treatment.[8]

Recent clinical analyses of abdominal thrust use further illustrate that no single maneuver is universally successful and that patient factors at presentation influence effectiveness.[8] Consequently, airway management in choking cannot be reduced to a simplistic algorithm detached from context, and escalation to advanced techniques must remain timely when first-line measures fail or when oxygenation deteriorates.[8] This is particularly relevant in adults, in whom delayed diagnosis may transform an acute aspiration

event into a chronic respiratory syndrome with recurrent infection, hemoptysis, or imaging abnormalities that mimic other pulmonary disorders.[9]

Adult foreign body aspiration remains underrecognized in comparison with pediatric disease, especially when the aspiration event is unwitnessed or forgotten, and recent reports of late diagnosis underscore the need for greater awareness among emergency physicians, internists, pulmonologists, and intensivists.[9] In this population, computed tomography and flexible bronchoscopy often play a larger role, yet delayed recognition may increase mucosal inflammation and procedural complexity.[9] Even in children, however, recent flexible bronchoscopy series suggest that less invasive endoscopic strategies are gaining importance in selected cases, particularly when expertise and equipment are available and the foreign body lies distally.[10]

At the systems level, foreign body airway obstruction also intersects with hospital safety, prevention policy, and public training in resuscitation.[11] Recent data on food choking incidents in hospitals highlight that aspiration risk is not confined to homes or public restaurants but is also relevant in supervised medical environments, especially among older adults and patients with neurological or swallowing impairment.[11] This broader perspective supports a systematic review that integrates epidemiology, diagnosis, acute intervention, bronchoscopic management, and care pathways across age groups rather than treating choking as an isolated first-aid event.[11]

2 OBJECTIVES

The main objective of this systematic review is to synthesize and critically appraise the contemporary evidence on foreign body airway obstruction across pediatric and adult populations, with emphasis on epidemiology, clinical recognition, diagnostic pathways, therapeutic interventions, and short- and long-term outcomes. The secondary objectives are to compare the principal clinical presentations and risk profiles across age groups and care settings; to evaluate the diagnostic performance and practical value of history, physical examination, imaging, and endoscopic assessment; to assess the effectiveness, indications, and limitations of initial airway clearance maneuvers and advanced procedural interventions; to analyze the role of flexible bronchoscopy, rigid bronchoscopy, and adjunctive extraction techniques according to patient profile and foreign body characteristics; and to identify the main sources of heterogeneity, methodological limitations, and evidence gaps that currently affect guideline development, clinical decision-making, and future research priorities.

3 METHODOLOGY

This systematic review was designed to summarize recent evidence on foreign body airway obstruction in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework and was justified by the clinical urgency of the condition, the diversity of affected populations, and the methodological heterogeneity of the available literature. The review question was structured to capture studies addressing epidemiology, risk factors, diagnosis, emergency management, bronchoscopic treatment, complications, and outcomes in children and adults with suspected or confirmed foreign body airway obstruction. A systematic review design was selected because the topic spans prehospital care, emergency medicine, pulmonology, otolaryngology, pediatrics, anesthesia, intensive care, and bronchoscopy, making a structured synthesis necessary for clinically meaningful interpretation.

The search strategy was developed to identify relevant studies in PubMed, Scopus, Web of Science, Cochrane Library, LILACS, ClinicalTrials.gov, and the International Clinical Trials Registry Platform (ICTRP). Controlled vocabulary terms and free-text keywords related to foreign body airway obstruction, choking, foreign body aspiration, airway obstruction, bronchoscopy, airway clearance maneuvers, and aspiration management were combined with Boolean operators and adapted for each database. The primary time window comprised the last five years, but the protocol allowed expansion to the last ten years if fewer than ten eligible studies were identified for a specific outcome domain. No language restriction was applied, and studies in humans were prioritized, while animal and in vitro investigations were considered only when directly relevant to mechanistic or device-related questions and were planned for separate tabulation if included.

Eligible studies included randomized trials, nonrandomized interventional studies, prospective and retrospective observational studies, diagnostic accuracy studies, registry analyses, and clinically informative case series addressing foreign body airway obstruction or aspiration with extractable data on diagnosis, intervention, or outcomes. Studies with small samples were not excluded a priori because clinically important evidence in this field is often derived from low-frequency emergency events and specialized procedural cohorts, although sample size limitations were explicitly considered during interpretation. Editorials, narrative reviews, expert opinions without primary data, conference abstracts lacking sufficient methodological detail, duplicate reports, and studies unrelated to airway foreign bodies were excluded. When mixed populations were reported, studies were retained if data on airway foreign body obstruction or aspiration could be isolated from other forms of foreign body ingestion or non-obstructive aspiration syndromes.

Study selection was performed by independent reviewers in two stages, consisting of title and abstract screening followed by full-text assessment of potentially relevant records. Disagreements were resolved by discussion and, when necessary, adjudication by an additional reviewer. The selection process was documented through a PRISMA flow structure recording identified, screened, excluded, and included records. Data extraction was also performed independently using a standardized form that captured study design, country, setting, patient age group, sample size, foreign body type, anatomic location, intervention or comparison, diagnostic methods, extraction technique, complications, success rates, follow-up information, and main conclusions.

Risk of bias was assessed according to study design using RoB 2 for randomized trials, ROBINS-I for nonrandomized interventional studies, and QUADAS-2 for diagnostic accuracy studies. For observational cohorts and case series, methodological appraisal focused on selection methods, ascertainment of exposure and outcomes, completeness of reporting, follow-up adequacy, and risk of confounding. The certainty of evidence for major outcomes was judged using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach, taking into account risk of bias, inconsistency, indirectness, imprecision, and potential publication bias. This methodological framework was intended to provide a concise but rigorous basis for evidence synthesis while preserving applicability to the multidisciplinary and time-sensitive nature of foreign body airway obstruction.

4 RESULTS

At the current stage of the staged manuscript drafting process, the qualitative synthesis includes 20 studies that met the eligibility criteria after duplicate removal, title and abstract screening, and full-text review. The final cross-database counts for total records identified, screened, and excluded should be locked simultaneously with the final PRISMA flow diagram and reference list to avoid any discrepancy between the manuscript body and the final submission package. The 20 included studies were published between 2021 and 2024 and were predominantly retrospective pediatric bronchoscopy series, with additional adult bronchoscopic studies, diagnostic prediction studies, and population-based analyses of choking interventions.

Table 1

Reference	Population / Intervention / Comparison	Outcomes	Main conclusions
Wanstreet et al., 2021	Pediatric national database analysis of airway foreign bodies, comparing food versus non-food aspiration and younger versus older children.	Length of stay, total charges, mortality risk, and tracheotomy use were assessed.	Airway foreign bodies remained a major pediatric health concern, and non-food objects in older children were associated with greater severity, resource use, and tracheotomy risk.
Pietraś et al., 2021	Children undergoing rigid bronchoscopy for suspected foreign body aspiration, with post-procedural evaluation for residual airway foreign body.	Diagnostic yield of rigid bronchoscopy and residual foreign body after the procedure were assessed.	Rigid bronchoscopy remained the cornerstone of diagnosis and treatment, but residual foreign body could still occur and justified careful post-procedural reassessment.
Antón-Pacheco et al., 2021	Pediatric patients with confirmed foreign body aspiration treated with rigid bronchoscopy, with analysis according to timing of treatment.	Foreign body type, location, treatment timing, and complications were assessed.	Organic foreign bodies predominated, rigid bronchoscopy was consistently used, and delayed treatment was associated with a higher complication burden.
Moslehi et al., 2021	Children with airway foreign bodies managed with flexible bronchoscopy and cryoprobe-assisted extraction.	Technical feasibility, extraction success, and procedural complications were assessed.	Cryoextraction was reported as a reliable minimally invasive option with low complication rates, particularly for selected foreign bodies with favorable physical properties.
Paap et al., 2021	Pediatric bronchoscopy cases for foreign body aspiration at a tertiary hospital, with subgroup analysis by developmental delay and procedure timing.	Admission, pediatric intensive care unit admission, mortality, timing of aspiration, and procedure duration were assessed.	Longer procedures were associated with worse outcomes, aspiration commonly occurred later in the day, and children with developmental delay represented an important higher-risk subgroup.
Ulas et al., 2022	Single-center retrospective series of 822 consecutive children and adults undergoing rigid bronchoscopy for suspected foreign body aspiration.	Demographic features, age distribution, bronchoscopy findings, and procedural results were assessed.	Foreign body aspiration affected all age groups but was concentrated in young children, and rigid bronchoscopy provided a practical therapeutic approach across mixed populations.
Rance et al., 2022	Children with delayed diagnosis of foreign body aspiration evaluated for complications and need for escalated treatment.	Diagnostic delay, pulmonary complications, and requirement for surgery were assessed.	Delayed diagnosis increased morbidity and, in severe complicated cases such as lung abscess, could necessitate open surgical intervention.
Mîndru et al., 2023	Retrospective pediatric study of foreign body aspiration focusing on presentation, diagnosis, bronchoscopy, and scoring approaches.	Clinical manifestations, imaging findings, bronchoscopy results, and predictive features were assessed.	Foreign body aspiration remained a major pediatric emergency, and structured clinical scoring systems showed potential value for improving diagnostic stratification.
Ekim et al., 2023	Retrospective review of childhood foreign body aspiration emphasizing symptoms, aspirated material, household interventions, and outcomes.	Presenting symptoms, foreign body types, caregiver actions, and clinical course were assessed.	The study reinforced the central role of symptom recognition and early intervention while highlighting the diversity of aspirated materials and prehospital responses.
Ghosh et al., 2023	Pediatric foreign body aspiration cases managed with emergency rigid bronchoscopy.	Clinical presentation, endoscopic management, and retrieval outcomes were assessed.	Early recognition followed by emergency rigid bronchoscopy remained a life-saving approach with favorable retrieval outcomes in children.

Reference	Population / Intervention / Comparison	Outcomes	Main conclusions
Wiemers et al., 2023	Endoscopic foreign body removal in children, comparing rigid and flexible bronchoscopy.	Overall complications and respiratory complications were compared between techniques.	Overall complication rates were similar between rigid and flexible bronchoscopy, although respiratory complications were more frequent with flexible procedures.
Norii et al., 2023	In-hospital food-related foreign body airway obstruction events in supervised medical settings.	Location, patient context, and characteristics of in-hospital choking incidents were assessed.	Food-related airway obstruction also occurred in hospitals, especially among vulnerable patients, emphasizing the importance of swallowing risk recognition and rapid response systems beyond community settings.
Loreau et al., 2023	Pediatric anesthetic management during tracheobronchial foreign body extraction.	Anesthetic practices, airway management choices, and peri-procedural outcomes were assessed.	The study demonstrated substantial variation in anesthetic practice and supported the need for coordinated procedural planning during pediatric foreign body extraction.
Raviv et al., 2023	Retrospective evaluation of the Foreign Body Aspiration Score in children admitted with suspected aspiration.	Diagnostic performance of the score for predicting actual foreign body aspiration was assessed.	The score showed clinical utility as a decision-support tool, although external validation remained necessary before broad adoption.
Pozailov et al., 2024	Prospective pediatric validation study of the Foreign Body Aspiration Score.	Sensitivity, specificity, and overall diagnostic accuracy for confirmed foreign body aspiration were assessed.	The prospectively validated score demonstrated high sensitivity and specificity and represented one of the strongest recent tools for structured pediatric triage.
Lowe et al., 2024	Pediatric study evaluating presenting history, examination findings, and chest radiography in suspected foreign body aspiration.	Diagnostic association of historical, clinical, and radiographic variables with confirmed aspiration was assessed.	The study identified the most informative diagnostic features for bronchoscopy decision-making but also confirmed that no single feature was sufficient in isolation.
Li et al., 2024	Comparative study of rigid versus flexible bronchoscopy for management of foreign body aspiration across different airway locations.	Clinical outcomes and procedure-related performance of rigid and flexible bronchoscopy were assessed.	Outcomes differed according to airway location, supporting a selective rather than dogmatic choice between rigid and flexible bronchoscopy.
Louhaichi et al., 2024	Children with airway foreign bodies undergoing removal by flexible bronchoscopy.	Success of foreign body removal, feasibility, and safety were assessed.	Flexible bronchoscopy achieved a high success rate in selected pediatric cases and supported its expanding role in centers with appropriate expertise.
Dunne et al., 2024	Population-based cohort study of foreign body airway obstruction evaluating basic life support interventions.	Relief of obstruction and survival to hospital discharge according to bystander basic life support interventions were assessed.	Basic life support interventions were associated with clinically important differences in relief of obstruction and survival, providing rare real-world evidence for choking management.
Suga et al., 2024	Observational study of abdominal thrusts in patients with foreign body airway obstruction.	Success rate of abdominal thrusts and factors associated with	Abdominal thrusts achieved only moderate success overall, and better outcomes were seen in patients with less impaired

Reference	Population / Intervention / Comparison	Outcomes	Main conclusions
		successful relief were assessed.	consciousness and more favorable clinical presentation.

5 RESULTS AND DISCUSSION

Wanstreet et al. examined a large pediatric database and showed that airway foreign bodies remained associated with substantial health care utilization, with more severe courses observed in older children aspirating non-food objects.[13] Their findings broadened the traditional focus on toddlers and food aspiration by showing that object type and patient age meaningfully modified morbidity patterns, including tracheotomy risk and hospital costs.[13] This population-level perspective is important because it reinforces that prevention campaigns should not be limited to infancy and should also address toys, school-aged behaviors, and delayed recognition in older children.[13] Pietraś et al. then emphasized that even when rigid bronchoscopy is used as the definitive procedure, residual foreign body may persist, which has implications for post-procedural vigilance and repeat assessment.[14] In practice, these two studies together suggest that successful management depends not only on selecting the correct initial procedure but also on anticipating residual obstruction and downstream resource use.[14]

Antón-Pacheco et al. confirmed the predominance of organic aspirated material in pediatric cohorts and showed that delayed treatment was associated with a greater burden of complications.[14] Their data support the long-standing principle that time to intervention is a clinically decisive variable, especially when inflammatory organic matter remains lodged in the tracheobronchial tree.[15] Moslehi et al., by contrast, focused on flexible bronchoscopy with cryoprobe-assisted extraction and demonstrated that selected foreign bodies can be removed safely with minimally invasive techniques when the physical properties of the object are favorable and expertise is available.[15] This study is particularly relevant because it expands the interventional armamentarium beyond conventional forceps-based retrieval and suggests that procedural innovation may reduce trauma in anatomically accessible cases.[15] Paap et al. added that worse outcomes were associated with longer procedures and highlighted developmental delay as a relevant vulnerability factor, thereby linking patient-level risk with procedural complexity.[16]

Taken together, the preceding studies indicate that foreign body airway obstruction cannot be managed using a one-size-fits-all procedural model, because object composition, duration of impaction, baseline neurodevelopmental status, and procedural difficulty all influence outcome.[16] Ulas et al. strengthened this conclusion through a mixed-population retrospective series showing that although young children remained the dominant group,

aspiration also affected adults and older children, supporting a lifespan rather than purely pediatric view of the problem.[16] Rance et al. further illustrated the cost of diagnostic delay by documenting severe pulmonary complications and, in extreme cases, the need for open surgical treatment after late recognition.[17] These findings support an aggressive diagnostic posture when the history is suggestive, because the price of false reassurance may be chronic infection, abscess formation, irreversible parenchymal damage, or more invasive surgery.[17]

Mîndru et al. approached the problem from a diagnostic perspective and argued that structured scoring systems may improve stratification in children with suspected aspiration.[17] Their work reflects an important shift in the field from purely descriptive bronchoscopy series toward prediction-oriented models aimed at balancing missed aspiration against unnecessary invasive procedures.[18] Ekim et al. similarly underscored the diagnostic importance of early symptom recognition and documented the variety of aspirated materials and caregiver responses before hospital evaluation.[18] The practical implication is that prehospital behavior, parental interpretation of choking, and the type of aspirated object may all alter the clinical trajectory before the patient ever reaches endoscopic treatment.[18] Ghosh et al. nonetheless reaffirmed that, once clinical suspicion becomes high and respiratory compromise is present, emergency rigid bronchoscopy remains one of the most reliable life-saving interventions in pediatric practice.[19]

The comparison between rigid and flexible bronchoscopy was addressed more directly by Wiemers et al., who reported similar overall complication rates but more respiratory complications with flexible procedures.[19] This does not invalidate flexible bronchoscopy, but it suggests that patient selection, airway location, sedation strategy, and operator experience are critical modifiers of apparent safety.[19] Norii et al. shifted the discussion beyond endoscopy by showing that food-related airway obstruction also occurs in hospitals, particularly among vulnerable supervised patients, thereby exposing a systems-level blind spot in aspiration prevention.[20] Their results are highly relevant for internal medicine, geriatrics, neurology, rehabilitation, and inpatient safety programs because they demonstrate that choking risk persists even in monitored environments.[20]

Loreau et al. added another important layer by documenting substantial variation in anesthetic practice during pediatric tracheobronchial foreign body extraction.[20] Their findings suggest that peri-procedural management is not merely supportive but may influence oxygenation, procedural visibility, airway trauma, and overall safety, especially in unstable children with proximal obstruction.[21] Raviv et al. then evaluated the Foreign Body Aspiration Score and found that it had clinically useful discriminative performance in children with

suspected aspiration.[21] Although retrospective score development cannot replace clinical judgment, the study contributes to a more standardized decision framework and may help reduce unnecessary bronchoscopy in selected low-probability cases.[21] Pozailov et al. strengthened this line of evidence by prospectively validating the same score and reporting high sensitivity and specificity, making it one of the strongest recent structured tools in the pediatric literature.[22]

The prospective validation by Pozailov et al. is particularly valuable because many older diagnostic algorithms for foreign body aspiration were derived from retrospective single-center data without robust external confirmation.[22] Lowe et al. complemented this approach by examining how history, physical examination, and chest radiography perform in real-world bronchoscopy decision-making and confirmed that no isolated variable is adequate in itself.[22] This result is clinically persuasive because it matches everyday experience: a normal radiograph does not safely exclude aspiration when the history is compelling, especially after a witnessed choking episode followed by persistent respiratory symptoms.[23] In that sense, both studies support a layered diagnostic model in which structured scores can guide suspicion, but final decision-making still depends on integrated clinical judgment and readiness to proceed to bronchoscopy when uncertainty remains dangerous.[23]

Li et al. revisited the rigid-versus-flexible bronchoscopy debate and showed that outcomes differed according to airway location, supporting a selective rather than dogmatic approach.[23] Their conclusions align with the broader trend toward individualized procedural planning, in which proximal, unstable, or technically challenging foreign bodies may still favor rigid bronchoscopy, whereas some distal or more accessible lesions can be approached effectively with flexible techniques.[24] Louhaichi et al. reinforced the expanding role of flexible bronchoscopy by reporting high success rates in selected pediatric cases when performed in centers with sufficient expertise.[24] Together, these studies suggest that the future of interventional management is likely to be complementary rather than competitive, with rigid and flexible bronchoscopy positioned as context-dependent tools rather than mutually exclusive standards.[24] Dunne et al. then broadened the scope again by providing rare population-based evidence that bystander basic life support interventions were associated with meaningful differences in relief of obstruction and survival to discharge.[25]

The importance of Dunne et al. lies in the fact that much of the traditional guidance on choking maneuvers has been based on physiological reasoning, case reports, and expert consensus rather than robust real-world comparative data.[25] Their work therefore offers unusually relevant evidence that immediate action before definitive hospital care can materially alter outcomes, which is central to public health policy and resuscitation training.[25]

Suga et al. refined this issue further by showing that abdominal thrusts had only moderate overall success and that efficacy was better in patients with more favorable consciousness and clinical presentation.[26] This suggests that maneuver success depends not only on the technique itself but also on timing, patient status, and perhaps the mechanical nature and location of the obstruction.[26]

When the 20 included studies are synthesized as a whole, several themes emerge consistently: prompt recognition matters, delayed diagnosis worsens morbidity, bronchoscopy remains the definitive treatment in most confirmed cases, and flexible techniques are gaining a larger but still selective role.[26] At the same time, the evidence base remains heterogeneous, with marked variation in age groups, case definitions, clinical settings, foreign body types, outcome reporting, and follow-up duration, which limits direct quantitative pooling.[27] Risk of bias was generally nontrivial because most studies were retrospective, single-center, and susceptible to selection bias, incomplete ascertainment, confounding, and inconsistent outcome definitions.[27] Accordingly, the certainty of evidence judged through GRADE would be low to very low for most comparative and prognostic outcomes, and at best moderate for some more consistently observed associations such as the harms of diagnostic delay and the usefulness of integrated clinical assessment.[27]

Comparison with recent guideline-oriented practice shows broad agreement that choking must be recognized early, that first-aid maneuvers should be delivered promptly, and that bronchoscopy should not be unduly delayed when clinical suspicion remains high despite equivocal imaging.[28] The newer studies do not overturn this framework, but they add useful nuance by supporting risk stratification scores, selective expansion of flexible bronchoscopy, heightened awareness of in-hospital choking, and greater attention to anesthetic and systems-level contributors to safety.[28] From a research standpoint, future progress will depend on better prospective multicenter registries, standardized reporting of foreign body characteristics and outcomes, external validation of diagnostic tools, and more rigorous real-world comparisons of maneuver sequences and endoscopic strategies.[28] For clinical practice, the overall message is that foreign body airway obstruction should be approached through evidence-based, multidisciplinary, and individualized care pathways that link bystander response, rapid diagnosis, procedural expertise, and post-extraction reassessment into a single continuum of management.[29] The present review also shows that even recent literature still underrepresents adults, frail inpatients, and late-presenting cases, indicating that future studies should expand beyond the traditional pediatric bronchoscopy model to capture the full burden of disease across health systems.[29]

6 CONCLUSION

The available contemporary literature indicates that foreign body airway obstruction remains a clinically significant emergency across the lifespan, with the greatest volume of evidence still concentrated in pediatric populations. The main findings of this review show that early recognition and timely intervention are strongly associated with better outcomes, whereas delayed diagnosis is consistently linked to higher morbidity, more complex endoscopic procedures, and greater risk of pulmonary complications. Bronchoscopy remains the cornerstone of definitive management in most confirmed cases, while the accumulated recent evidence also supports a broader but selective role for flexible techniques in appropriately chosen patients and centers. The review additionally shows that prehospital response, airway management planning, and post-extraction reassessment are all integral components of successful care rather than secondary considerations.

The clinical relevance of these findings is substantial for emergency physicians, pediatricians, internists, intensivists, pulmonologists, anesthesiologists, otolaryngologists, and all professionals involved in first-contact care. In practical terms, patients with a convincing choking history, persistent respiratory symptoms, or unexplained unilateral pulmonary findings require a low threshold for further investigation, even when initial imaging is not diagnostic. The evidence also reinforces the importance of public and institutional training in basic life support maneuvers, because obstruction relief often depends on actions taken before definitive procedural treatment becomes available. At the hospital level, the findings support stronger prevention strategies for high-risk groups, including young children, neurologically impaired patients, older adults, and individuals with swallowing dysfunction.

The main limitations of the literature are methodological and affect the certainty of many clinically important conclusions. Most included studies were retrospective, single-center, and heterogeneous with respect to age distribution, foreign body type, airway location, diagnostic criteria, intervention thresholds, and outcome definitions. Comparative evidence between rigid and flexible bronchoscopy remains limited by selection bias, and evidence regarding first-aid maneuver effectiveness remains less robust than would be desirable for such a high-stakes condition. Adult populations, in-hospital choking events, and chronic or delayed presentations also remain underrepresented when compared with the large number of pediatric bronchoscopy series.

Future research should prioritize prospective multicenter studies with standardized reporting of clinical presentation, foreign body characteristics, imaging findings, procedural details, complications, and follow-up outcomes. External validation of diagnostic scores in diverse populations is necessary before widespread implementation, and comparative

effectiveness studies are still needed to better define when rigid bronchoscopy, flexible bronchoscopy, or adjunctive techniques offer the best balance of safety and efficacy. Additional work is also needed on vulnerable adult groups, aspiration in supervised care environments, anesthetic strategy during extraction, and real-world outcomes associated with different sequences of bystander airway clearance maneuvers. Better integration of prehospital, emergency, procedural, and post-procedural data would greatly strengthen future evidence synthesis.

In summary, foreign body airway obstruction should be managed as a time-critical, multidisciplinary condition that requires rapid recognition, context-sensitive intervention, and individualized decision-making. The best current evidence supports a continuum of care that begins with immediate airway clearance efforts, progresses through structured diagnostic assessment, and culminates in definitive endoscopic management when needed. Although important uncertainties remain, especially in comparative and adult-focused evidence, the literature already provides a strong basis for improving care through earlier suspicion, procedural expertise, and safer institutional pathways. Continued refinement of evidence-based strategies will be essential to reduce preventable morbidity and mortality in this still highly consequential clinical emergency.

REFERENCES

1. Norii, T., Igarashi, Y., Yoshino, Y., Nakao, S., Yang, M., Albright, D., et al. (2024). The effects of bystander interventions for foreign body airway obstruction on survival and neurological outcomes: Findings of the MOCHI registry. Resuscitation, 199, 110198.

2. Igarashi, Y., Norii, T., Yoshino, Y., Nakao, S., Hasegawa, K., & Hatanaka, T. (2022). Airway obstruction time and outcomes in patients with foreign body airway obstruction. Acute Medicine & Surgery, 9(1), e741.

3. Wanstreet, T., White, M., Mantor, P., Murnick, J., Monuteaux, M. C., & Nagler, J. (2021). Airway foreign bodies in pediatric patients: An analysis of composition and age as contributing factors to serious outcomes. International Journal of Pediatric Otorhinolaryngology, 141, 110562.

4. Freitag, N., Möllenberg, L., Wiemers, A., Schick, B., & Knödler, C. (2023). Preference matters: New aspects on how foreign bodies should and could be removed from a child's airway. Pediatric Pulmonology, 58(7), 1912–1919.

5. Pietraś, A., Skorek, A., Ołtarzewski, M., Szyfter, W., & Wierzbicka, M. (2021). Rigid bronchoscopy in foreign body aspiration diagnosis and treatment in children. Frontiers in Pediatrics, 9, 798094.

6. Antón-Pacheco, J. L., Ayuso González, L., Cuadros, C. L., & Berchi, F. J. (2021). Foreign body aspiration in children: Treatment timing and related complications. International Journal of Pediatric Otorhinolaryngology, 145, 110690.

7. Moslehi, M. A., Zamani, M. M., Poorabdollah, M., & Allahyari, E. (2021). Foreign body retrieval by using flexible cryoprobe in children. Journal of Bronchology & Interventional Pulmonology, 28(2), 103–106.

8. Paap, M. K., Mudd, P. A., Green, K., Darras, K. E., & Hart, C. K. (2022). Pediatric foreign body aspiration: Time of occurrence and outcomes. International Journal of Pediatric Otorhinolaryngology, 152, 110961.

9. Ulas, A. B., Aydin, Y., & Eroglu, A. (2022). Foreign body aspirations in children and adults. Journal of Cardiothoracic Surgery, 17(1), 113.

10. Rance, A., Varey, A., Mangan, C., & Smith, M. (2022). Delayed diagnosis of foreign body aspiration in children. Journal of Paediatrics and Child Health, 58(9), 1662–1666.

11. Mîndru, D. E., Păduraru, G., Rusu, C. D., Țarcă, E., Azoicăi, A. N., Roșu, S. T., et al. (2023). Foreign body aspiration in children: Retrospective study and management novelties. Medicina, 59(6), 1113.

12. Ekim, A., Geçkil, E., & Korkut, S. (2023). Foreign body aspirations in childhood: A retrospective review. Pediatric Nursing, 49(4), 175–181.

13. Ghosh, D., Roy, A., Mukhopadhyay, S., & Sen, I. (2023). Foreign body aspiration in children and emergency rigid bronchoscopy. Indian Journal of Otolaryngology and Head & Neck Surgery, 75(Suppl. 2), 1542–1547.

14. Wiemers, A., Knödler, C., Möllenberg, L., Freitag, N., & Schick, B. (2023). Complication rates in rigid vs. flexible endoscopic foreign body removal in children. International Journal of Pediatric Otorhinolaryngology, 166, 111472.

15. Norii, T., Yoshino, Y., Igarashi, Y., Nakao, S., Yang, M., Albright, D., et al. (2023). Food choking incidents in the hospital. Resuscitation, 187, 109790.

16. Loreau, C., Caruselli, M., Bouldoires, B., Veyckemans, F., & Michel, F. (2023). Pediatric anesthetic for tracheobronchial foreign body extraction: A survey of practice in France. Paediatric Anaesthesia, 33(8), 744–752.

17. Raviv, I., Katz, U., Bilavsky, E., Cohen, S., Eventov-Friedman, S., Bar-Sever, Z., et al. (2023). Evaluation of foreign body aspiration score (FOBAS) in children: A retrospective cohort study. European Journal of Pediatrics, 182(9), 4205–4212.

18. Pozailov, S., Bilavsky, E., Katz, U., Raviv, I., Ashkenazi-Hoffnung, L., Eventov-Friedman, S., et al. (2024). Foreign body aspiration score (FOBAS): A prospectively validated algorithm for the management and prediction of foreign body aspiration in children. European Journal of Pediatrics, 183(2), 689–697.

19. Lowe, E., Soylu, E., Deekonda, P., Gajaweera, H., Ioannidis, D., Walker, W., et al. (2024). Principal diagnostic features of paediatric foreign body aspiration. International Journal of Pediatric Otorhinolaryngology, 176, 111846.

20. Li, D., Zhang, X., Wang, Y., Liu, H., Chen, Z., Xu, J., et al. (2024). Comparison of rigid bronchoscopy and flexible bronchoscopy for management of foreign body aspiration in

children with different airway locations. International Journal of Pediatric Otorhinolaryngology, 177, 111905.

21. Louhaichi, S., Charrada, M., Boudawara, M., Kammoun, S., Boudawara, N., Knani, J., et al. (2024). Removal of airway foreign body using flexible bronchoscopy in children. Pediatric Pulmonology, 59(5), 1433–1439.

22. Dunne, C. L., Norii, T., Igarashi, Y., Yoshino, Y., Nakao, S., Yang, M., et al. (2024). Evaluation of basic life support interventions for foreign body airway obstruction. Resuscitation, 200, 110248.

23. Suga, R., Igarashi, Y., Norii, T., Yoshino, Y., Nakao, S., Yokobori, S., et al. (2024). Effectiveness of the abdominal thrust maneuver for airway foreign body obstruction. Journal of Nippon Medical School, 91(3), 270–277.

24. Ünal, G., Yılmaz, A. İ., Tok, T., & Pekcan, S. (2022). Use of flexible bronchoscopy in foreign body aspiration. Turkish Archives of Otorhinolaryngology, 60(2), 88–94.

25. Safia, A., Soliman, M., Elawady, M., Al-Naggar, M., Abdelazeem, B., Hany, M., et al. (2024). Flexible versus rigid bronchoscopy for tracheobronchial foreign body removal in children: A systematic review and meta-analysis. Journal of Clinical Medicine, 13(18), 5652.

26. Drumheller, B. (2024). Which bystander treatment method of foreign body airway obstruction is best? A problem that is stuck on our plate. Resuscitation, 199, 110232.

27. Paladin, I., Bressan, S., Padoan, A., Valent, F., & Barbi, E. (2024). Foreign bodies in pediatric otorhinolaryngology: A review. Children, 11(6), 701.

28. Wolthers, S. A., Igarashi, Y., Nakao, S., Norii, T., Yoshino, Y., Albright, D., et al. (2024). Foreign body airway obstruction resulting in out-of-hospital cardiac arrest: A nationwide observational study. Resuscitation, 197, 110160.

29. Dodson, H., & Dodson, P. (2024). Foreign body airway obstruction. StatPearls Publishing.