



Fatal food bolus airway obstruction: Part one – Forensic investigations and toxicological findings

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ABSTRACT

Food bolus airway obstruction (FBAO), traditionally described as café coronary, is a well-recognized but often underestimated cause of unexpected death in adults. Comprehensive forensic studies integrating circumstantial evidence, autopsy findings, dentition status, and toxicological data remain limited.

We conducted a retrospective analysis on cases of fatal FBAO examined at the Institute of Legal Medicine of the University of Modena (Italy) over a 25-year period (1997–2022). For each case, we reviewed demographic characteristics, circumstances of death, clinical history, oral cavity findings, bolus characteristics, and complete toxicological results.

The cohort included 11 males and 7 females. Most deaths occurred at home (50%) and were unwitnessed. Comorbidities were present in 16 subjects (88.9%), predominantly neurological or psychiatric disorders. Dentition assessment was available in 11 cases: 9 individuals (81.8%) showed partial or complete edentulism. Meat was the most common obstructing material (85.7%), and multiple boluses were identified in 76.5% of cases. Toxicological analyses were available in 16 subjects, all of whom tested positive for at least one xenobiotic. Ethanol was found in 56.3% (two cases > 3.0 g/L), and psychotropic medications—mainly benzodiazepines and antipsychotics—were detected in 81.3%.

Fatal FBAO emerges as a multifactorial event resulting from the convergence of impaired mastication, neurological or psychiatric vulnerability, sedative medications, alcohol consumption, and adverse circumstances. Our results highlight the need for a systematic forensic approach that includes airway inspection, oral cavity evaluation, and comprehensive toxicology. Preventive strategies should prioritize dysphagia recognition, supervision during meals, dental rehabilitation, and careful review of sedative drugs in at-risk populations.

1. Introduction

Food bolus airway obstruction (FBAO)—historically referred to as café coronary—represents a well-recognized but still underestimated cause of sudden, unexpected death in adults. The term, introduced in the early 20th century to describe deaths occurring in public places during meals, typically involves the impaction of a large, insufficiently chewed piece of food within the upper airway, leading to acute and often silent

asphyxia. Although first conceptualized as a purely mechanical event, the underlying pathophysiology remains the subject of debate, as both obstructive asphyxia and reflex cardiac inhibition mediated by vagal stimulation have been implicated [1].

Epidemiological data indicate that fatal choking is rare in the general adult population, yet its true incidence is likely underreported [2]. Food is the most common obstructive material, with meat, sausages, and other solid organic items accounting for the majority of cases [1]. Adult

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victims often belong to high-risk groups characterized by impaired mastication, reduced airway protection reflexes, or altered sensorimotor control of swallowing—conditions documented in neurological and psychiatric disorders, cognitive impairment, and in individuals with poor dentition or edentulism [2,3]. Psychotropic medications and alcohol, by depressing central nervous system responsiveness and blunting protective reflexes, represent additional enabling factors consistently reported in fatal bolus asphyxia [1,3].

Several studies emphasize the role of alcohol intoxication, which can impair coordination, diminish pharyngeal and laryngeal reflexes, and delay effective responses to airway compromise. In large forensic series, elevated blood alcohol concentrations were documented in up to 40% of bolus-death victims [1]. Similarly, drugs like benzodiazepines, anti-psychotics, or antiepileptics may contribute to dysphagia, sedation, or reduced respiratory drive, thus increasing vulnerability during food intake [3].

Beyond mechanical obstruction, some authors have stressed the potential contribution of reflex vagal inhibition triggered by stimulation of the laryngeal inlet, which may precipitate sudden cardiac arrest even before complete asphyxia develops [1]. Distinguishing between these mechanisms is clinically and medicolegally relevant but often challenging, given the rapidity of collapse and the paucity of pathognomonic autopsy findings.

Although paediatric choking is widely represented in the scientific literature [4], adult bolus asphyxia has received comparatively little attention, despite its substantial medicolegal implications. Adults frequently choke at home, often unwitnessed, and resuscitation attempts may be delayed or absent. In individuals with neurological disease, developmental disorders, or psychiatric illness, swallowing impairment is frequently underrecognized and insufficiently monitored [3]. Moreover, poor dental status—including partial or complete edentulism—is consistently reported as a major predisposing factor, as it limits proper mastication and increases the likelihood of swallowing inadequately chewed boluses [1,2].

From a forensic perspective, systematic documentation of the characteristics of the bolus, its anatomical location, and associated autopsy findings—including signs of mechanical asphyxia or competing natural disease—is essential for accurate diagnosis and cause-of-death determination [1]. Toxicological evaluation is likewise crucial, as alcohol or psychoactive drugs may play a contributory or precipitating role.

Despite the accumulating literature, comprehensive forensic studies combining autopsy, circumstantial data, dentition assessment, and toxicological screening remain limited. There is therefore a need to expand current knowledge and better characterize the interplay between clinical history, enabling factors, anatomical findings, and toxicological profiles in adult bolus asphyxia.

The aim of this study is to retrospectively analyze 18 cases of fatal FBAO examined over a 25-year period, integrating circumstantial information, autopsy and dentition findings, characteristics of the obstructing material, and complete toxicological analyses. This multi-dimensional approach seeks to contribute to a more refined understanding of the medicolegal aspects and risk factors associated with this form of sudden death.

2. Materials and methods

2.1. Study design and case selection

This study is a retrospective analysis of post-mortem examinations performed at the Institute of Legal Medicine of the University of Modena (Italy) over a 25-year period (1997–2022). During the study period (1997–2022), all forensic autopsies performed at the Institute of Legal Medicine were retrospectively reviewed. In Italy, forensic autopsies are performed upon judicial request by the Public Prosecutor within the framework of the death investigation system. Circumstantial and anamnestic information was obtained from official documentation

available at the time of the autopsy, including police reports, medical records, and witness statements when available.

Cases were initially screened for suspected deaths due to airway obstruction. Inclusion criteria were: (i) autopsy-confirmed FBAO as the primary cause of death and (ii) availability of sufficient autopsy and circumstantial documentation. Cases in which airway obstruction was not confirmed at autopsy or in which documentation was incomplete were excluded. Two forensic pathologists independently reviewed the full autopsy reports, external examination records, and associated documentation to confirm eligibility. After application of these criteria, 18 cases were included in the final analysis.

Ethics committee approval was not required because the study was based on retrospective analysis of judicial forensic autopsies performed as part of routine institutional activity. All data were fully anonymised prior to analysis.

In each case, external examination and autopsy were performed according to the ECLM recommendations [5]. Toxicological analyses were performed in 16 out of the 18 cases. Biological matrices such as peripheral blood and urine—along with bile or tissue samples including liver or brain—were analysed. Ethanol was quantified by validated headspace gas chromatography (HS-GC/FID) using dual-column confirmation. Screening and confirmation of pharmaceutical agents and illicit substances were carried out using standard forensic toxicology techniques, primarily gas chromatography–mass spectrometry (GC–MS) and liquid chromatography–tandem mass spectrometry (LC–MS/MS).

2.2. Data collection

For each case, all available information was retrospectively retrieved and subsequently anonymised. Circumstantial and anamnestic data included demographic characteristics (sex and age), the circumstances of death (place of the event, presence or absence of witnesses, and whether emergency medical services initiated resuscitation), and clinical information concerning pre-existing cardiac, neurological, or psychiatric conditions, as well as any documented history of chronic pharmacological therapy or alcohol misuse.

Autopsy reports were reviewed in detail to identify the relevant external and internal findings, with particular attention to the characteristics of the obstructing food bolus, including its composition, number, and anatomical location within the upper airway. When documented, the condition of the oral cavity and dentition—such as the degree of edentulism and the presence of dental prostheses—was also recorded. Toxicological reports were analysed to determine the presence or absence of ethanol, pharmaceutical agents, and illicit substances.

3. Results

3.1. Circumstantial and anamnestic characteristics

The study cohort consisted of 18 individuals, 11 males (61.1%) and 7 females (38.9%), with ages ranging from 25 to 77 years (mean age: 53 years). Males were slightly younger than females (mean age 50 vs. 57 years). More than half of the subjects (10/18; 55.6%) were between 31 and 60 years old.

Regarding the circumstances of death, half of the events (9/18; 50%) occurred in the decedent's private residence, while four deaths (22.2%) took place in healthcare facilities. The remaining cases occurred in a bar, in a vehicle, in a detention facility, or in other isolated settings. Information on the presence of witnesses was available for 16 cases: in only 5 of these (31.3%) the event had been observed by bystanders. The high proportion of unwitnessed events may have contributed to delayed recognition of airway obstruction and limited opportunities for timely intervention.

Emergency medical services intervened in 15 cases, and cardiopulmonary resuscitation was attempted in 10 of them (66.7%), while in the remaining five instances the subject was found deceased. Detailed

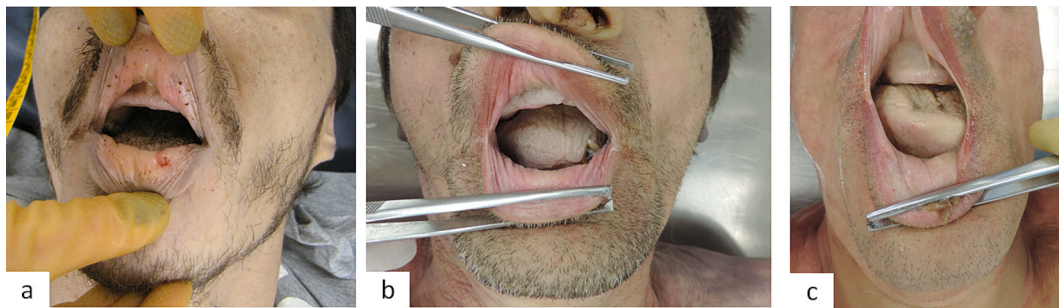


Fig. 1. Complete edentulism (a–c), illustrating the absence of effective mastication as a major predisposing factor for food bolus airway obstruction.

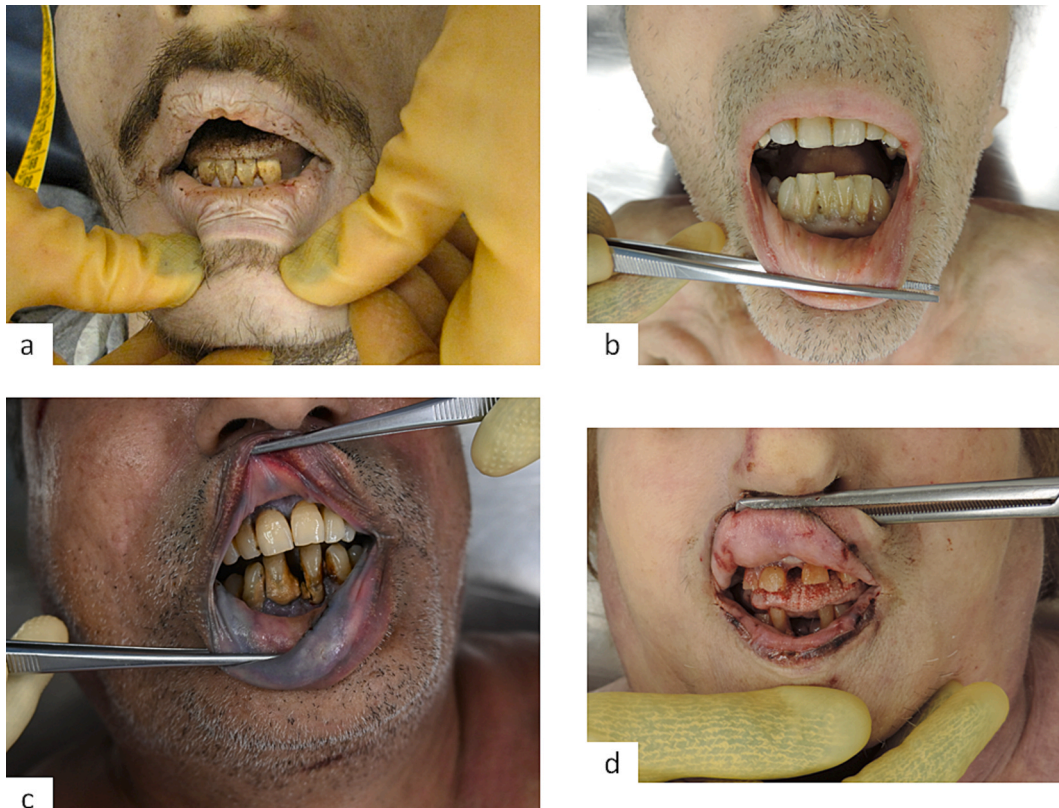


Fig. 2. Partial edentulism (a–d), associated with impaired mastication and an increased risk of swallowing inadequately chewed food boluses.

information regarding emergency airway management procedures (e.g., tracheal intubation or attempts at manual removal of the obstructing material) was not consistently available in all case records due to the retrospective nature of the study. When documented, emergency interventions were recorded.

3.2. Clinical history and comorbidities

Clinical–anamnestic information revealed that 16 out of 18 subjects (88.9%) had a history of comorbid conditions. Among these, 7 individuals presented exclusively neurological or psychiatric disorders, 4 had cardiac disease only, and 5 exhibited both cardiological and neuropsychiatric comorbidities. Neurological and psychiatric diagnoses included dementia, chronic vascular encephalopathy, post-traumatic dysphagia, obsessive–compulsive eating disturbances, Prader–Willi syndrome, anxiety and depressive disorders, epilepsy, schizophrenia, and other chronic psychoses. Cardiac conditions comprised arterial hypertension, cardiomyopathy, myocardial sclerosis, fibrosis, and cardiomegaly. A history of chronic alcohol misuse was reported in three

cases.

3.3. Oral cavity and dentition

Information on dentition was available for 11 subjects. Only two individuals (18.2%) had preserved dentition, while nine (81.8%) showed partial or total edentulism (Figs. 1, 2). Three subjects were completely edentulous, six presented partial or subtotal edentulism, and dental prostheses were documented in one case. Poor dentition appeared to represent a significant contributory condition in the majority of the cases.

3.4. Characteristics of the food bolus

Information on the obstructing bolus was available for all 18 cases. In 15 cases, the exact anatomical location of the bolus was documented: in 5 individuals (33.3%) the material was lodged in the pharynx and/or larynx, in 3 (20.0%) in the trachea, while in 7 cases (46.7%) food fragments were found in multiple locations, including the oral cavity,

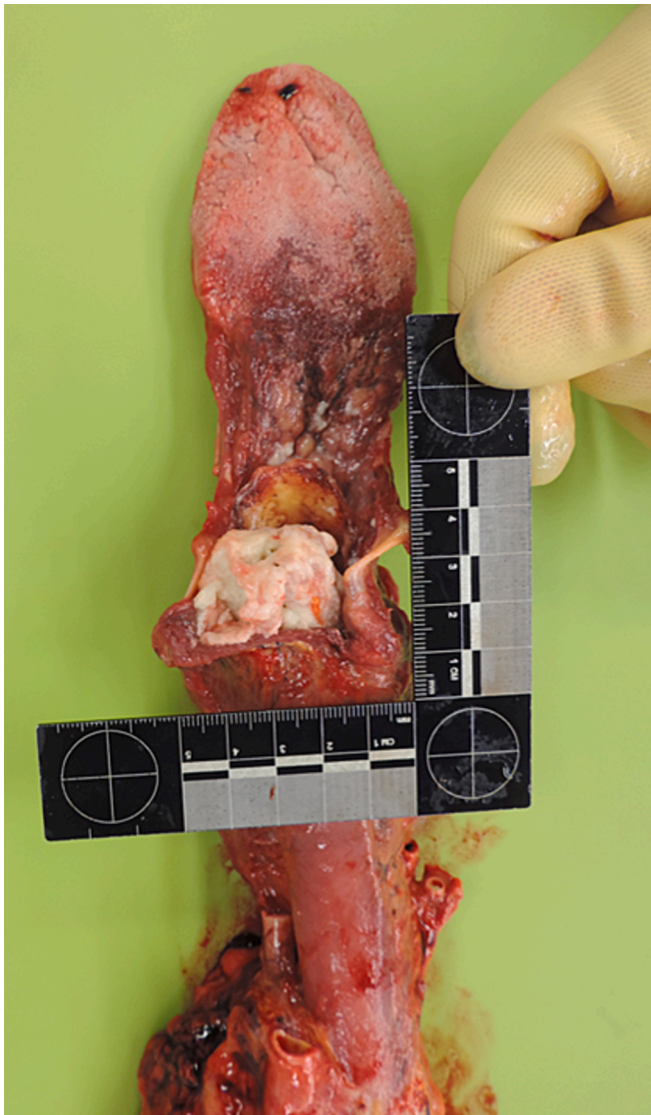


Fig. 3. Food bolus lodged in situ within the upper airway (a), causing acute mechanical obstruction.

trachea, extrapulmonary bronchi, and esophagus (Figs. 3, 4).

The composition of the bolus was described in 14 cases. Meat was the predominant component, involved in 12 cases (85.7%), either alone or mixed with vegetables or other food items (Fig. 4). Other documented materials included fragments of citrus fruit and vegetables. In one case, the obstructing bolus consisted of a 104-gram piece of raw beef swallowed by a subject affected by sarcophagia. Multiple boluses were recovered in 13 cases (76.5%), whereas a single bolus was identified in the remaining four.

3.5. Toxicological findings

Toxicological analyses were available for 16 cases. All 16 subjects tested positive for at least one xenobiotic. Ethanol was detected in nine individuals (56.3%), with blood concentrations exceeding 1.0 g/L in several cases and reaching levels above 3.0 g/L in two female subjects, both consistent with acute alcohol intoxication.

Pharmaceutical agents were identified in 13 cases (81.3%). Benzodiazepines and antipsychotics were the most frequently detected drug classes. Six subjects had taken a single psychotropic drug (four benzodiazepines and two antipsychotics), whereas seven exhibited polypharmacy involving combinations of benzodiazepines and

antipsychotics, occasionally together with additional therapeutic agents such as antiepileptics or cardiovascular medications.

Illicit substances were detected in two cases: Δ^9 -tetrahydrocannabinol in one individual, and codeine (in combination with paracetamol, haloperidol, diazepam, and delorazepam) in another. These substances were always found in association with alcohol and/or prescription medications. Toxicological interpretation was primarily based on blood concentrations, while non-blood matrices were used as supportive information. Detected drug concentrations were interpreted with reference to published therapeutic and toxic ranges when available.

Results are reported in detail in Table 1.

4. Discussion

Fatal FBAO represents a multifactorial and diagnostically challenging cause of sudden death, particularly in vulnerable adult populations. The findings of this retrospective study confirm many of the patterns described in the literature, while also offering new insights—especially in relation to toxicological profiles—that contribute to a more nuanced understanding of predisposing factors and medico-legal implications. Rather than acting as isolated determinants, the factors identified in this cohort appear to interact in a multifactorial manner, where anatomical vulnerability (impaired dentition), functional impairment (neurological or psychiatric disease), and chemical predisposition (alcohol and psychoactive drugs) converge to increase the risk of fatal food bolus airway obstruction.

4.1. Demographic and circumstantial features

The demographic characteristics of our cohort, with a predominance of middle-aged and older adults and a slight male prevalence, align closely with the major forensic series published to date [1,6]. Similar to previous studies, most events in our series occurred in private residences and frequently in unwitnessed circumstances. Wick et al. [6] and Aquila et al. [7,8] emphasize that delayed recognition of airway obstruction is a fundamental determinant of fatal outcome, particularly when the collapse occurs abruptly and silently, or among individuals living alone or in institutionalized settings. The fact that bystanders witnessed the event in only one-third of the cases in our series reinforces the typical scenario of sudden airway compromise without adequate or timely intervention, further highlighting the importance of careful circumstantial reconstruction and scene information in the medico-legal interpretation of these deaths [9].

4.2. Clinical comorbidities and functional vulnerability

Neurological and psychiatric disorders were the most frequent comorbidities in our cohort, consistent with the patterns documented by Wick et al. [6], Nikolić et al. [10], Tamuli et al. [11], and Atreya et al. [12]. These conditions—including dementia, developmental syndromes, cognitive impairment, post-traumatic dysphagia, epilepsy, and chronic psychoses—are known to impair the coordination of swallowing, diminish protective airway reflexes, and increase the likelihood of aspirating or swallowing inadequately chewed food. Several authors have stressed that dysphagia often goes unrecognized or is under-monitored in both psychiatric populations and residents of long-term care facilities [7,12], making mealtime a moment of heightened vulnerability.

Cardiovascular comorbidities were also common in this series, although their role is mostly indirect. While cardiac disease may not directly precipitate bolus obstruction, it reduces physiological reserve and increases the risk of sudden collapse once hypoxia develops. This has been reported in both forensic and clinical settings, where pre-existing cardiovascular impairment frequently coexists with airway obstruction but does not necessarily constitute the primary mechanism of death [13,14].

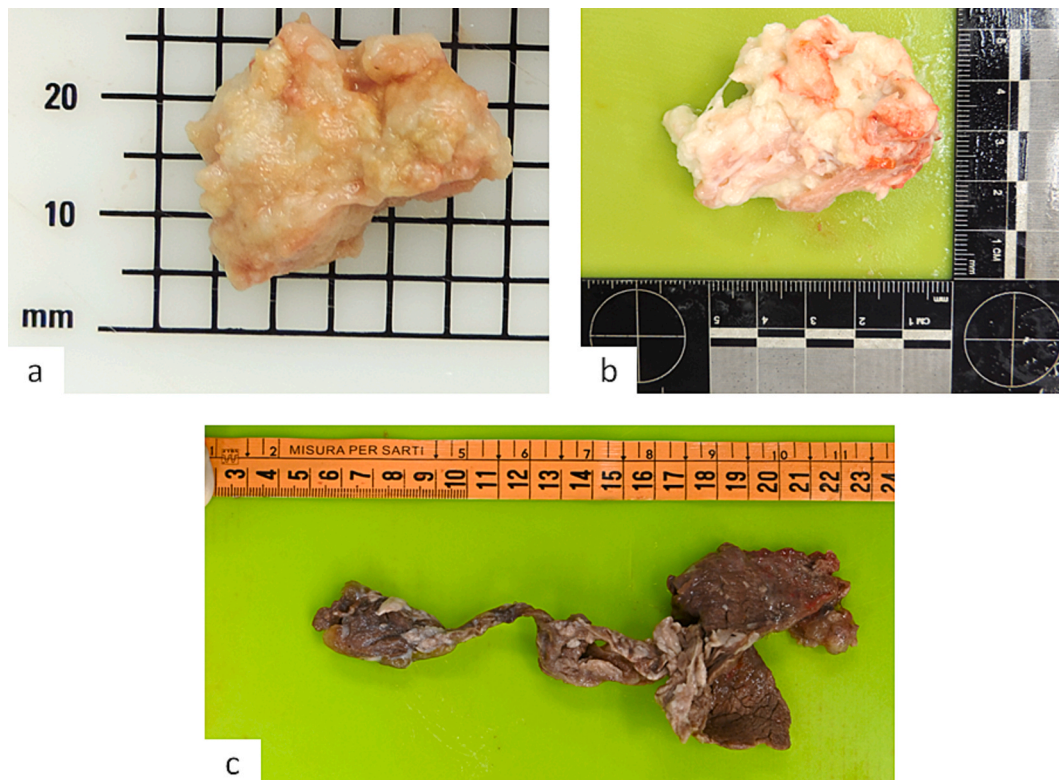


Fig. 4. Food bolus after removal (a–c), showing the size, consistency, and composition of the obstructing material.

4.3. Dentition status and mastication impairment

One of the most striking findings of this study is the extremely high prevalence of poor dentition: more than 80% of individuals with available data had partial or complete edentulism. This exceeds the prevalence reported in most of the major series—63% in Wick et al. [6], 58% in Nikolić et al. [10]—and confirms that compromised mastication capacity is among the major contributing factors in this cohort. Inadequate mastication results in the swallowing of large, fibrous food fragments, particularly meat, which remains the predominant obstructing material in both our study and the broader literature [1,13].

Our data suggest that dentition assessment should be systematically conducted and reported in all suspected choking deaths, as it is often a crucial determinant of risk. This aligns with recent preventive recommendations emphasizing oral health, dental prosthesis functionality, and dietary modifications for individuals with mastication impairment [2].

4.4. Characteristics of the food bolus

The predominance of meat-based boluses (85.7%) closely mirrors findings from Blaas et al. [1] and Wick et al. [6], who both reported meat and sausages as the most commonly implicated food types. The high proportion of cases with multiple boluses (76.5%) is also notable and has been described in other series as indicative of repeated attempts to swallow or fragment food during distress [13]. The presence of material across multiple anatomical compartments—including the pharynx, trachea, proximal bronchi, and even the oesophagus—supports the dynamic nature of airway obstruction, with bolus migration likely occurring during agonal respiratory efforts or manipulation during rescue attempts.

The occurrence of atypical boluses, such as citrus fruit fragments or the large raw beef piece associated with sarcophagia in one of our cases, further illustrates that while meat predominates, any poorly chewed and improperly sized food item may become obstructive under the right

circumstances.

4.5. Toxicological findings and the role of alcohol and drugs

Toxicological findings represent one of the most distinctive aspects of this study. All subjects undergoing toxicological analysis tested positive for at least one xenobiotic, and the prevalence of ethanol and psychoactive drugs was higher than that reported in most previous forensic series. Ethanol was detected in more than half of the cases, including two subjects with concentrations consistent with acute intoxication. These findings support the well-established role of alcohol in impairing mastication, depressing protective airway reflexes, and increasing vulnerability to choking events [1,10].

Psychotropic medications, mainly benzodiazepines and antipsychotics, were frequently identified and often involved in polypharmacy patterns. Sedative drugs may reduce consciousness, impair neuromuscular coordination, and delay the recognition of airway obstruction, thereby increasing the risk of fatal outcomes [3,6,7]. The combined presence of alcohol and sedative medications, observed in several cases, likely exerts a synergistic depressive effect on protective reflexes, emphasizing that fatal bolus obstruction cannot always be interpreted as a purely mechanical event [13,14].

Our findings are consistent with recent observations highlighting the role of drug-induced dysphagia and neurological vulnerability in fatal choking [15]. However, unlike previous case-based reports, the present study demonstrates a systematic toxicological involvement in a larger retrospective forensic cohort, supporting the concept that pharmacological and chemical impairment frequently act as enabling factors in fatal FBAO rather than incidental findings.

4.6. Mechanism of death: obstruction versus reflex cardiac inhibition

While mechanical obstruction remains the primary mechanism of death in most choking cases, the literature continues to debate the contribution of reflex cardiac inhibition mediated by vagal

Table 1

Overview of the 18 cases of fatal bolus airway obstruction. Abbreviations: CPR (Cardiopulmonary resuscitation); COPD (Chronic obstructive pulmonary disease); OCD (Obsessive–compulsive disorder); THC (Δ^9 -tetrahydrocannabinol); THC-COOH (11-nor-9-carboxy-THC). Peripheral blood: femoral blood; cardiac blood: central blood sampling from the heart.

| Case | Sex, Age | Place of event | Circumstantial data | Medical history | Toxicological findings | Ethanol | Dentition | Food bolus characteristics | Food bolus location |
|------|----------|-------------------------------|-----------------------------|---|--|----------------------------|---|--|---|
| 1 | M, 54 | Private home | No witnesses; no CPR | Hypertension; anxiety–depressive disorder | <u>Lorazepam</u> : Peripheral blood 945 ng/mL; Brain 1967 ng/g | 1.97 g/L | Not reported | Yellowish pasty material | Oral cavity, pharynx, larynx |
| 2 | M, 67 | Car | No witnesses; CPR not known | Hypertension | No samples collected | Not tested | Total edentulism; dental prosthesis present | Yellowish/oval masses ($\approx 6 \times 5$ cm and 4.5×3.5 cm), likely bread roll | Oropharynx and laryngeal inlet; fragments in esophagus, trachea, main bronchi |
| 3 | M, 55 | Bar | Witnessed; CPR performed | None | Negative | 2.25 g/L | Subtotal edentulism | Whitish pasty fragment ($\approx 5.5 \times 3.5$ cm) | Trachea, 1 cm below laryngeal inlet |
| 4 | F, 25 | Private home | Witnessed; CPR performed | Prader–Willi syndrome; psychiatric therapy | <u>Clozapine</u> : Peripheral blood 668 ng/mL; Brain 1537 ng/g; Cardiac blood 1851 ng/g; N-desmethylclozapine: Blood 971 ng/mL | Negative | Good | Whitish–yellow pasty material; ovoid masses (2.5×1.5 cm; $5 \times 3.5 \times 1$ cm) | Supraglottic region and laryngeal inlet; small amount in trachea |
| 5 | F, 74 | Private home | No witnesses; no CPR | Smoking; COPD; cardiopathy; blindness | <u>Alprazolam</u> : Pleural effusion 0.58 g/L; Brain 22.7 ng/g; Liver 151 ng/g; Stomach 460 ng/g | Pleural effusion 0.28 g/kg | Partial edentulism, upper arch | Pinkish pasty material with meat filaments | Laryngeal inlet; material in esophagus, trachea, left bronchus |
| 6 | M, 38 | Private home | No witnesses; CPR performed | Possible epilepsy | <u>Hydroxyalprazolam</u> : Liver 13.6 ng/g; <u>Clonazepam</u> : Peripheral blood 43.6 ng/mL, Brain 354 ng/g; <u>Aminoclonazepam</u> : Peripheral blood 865 ng/mL, Brain 601 ng/g; <u>THC-COOH</u> : Peripheral blood 3.8 ng/mL, Brain 3.6 ng/g | Not reported | Not reported | “Vomit-like” pasty material, chewing-gum, meat 10×5 cm, whitish-yellow fragments | Piriform recesses and trachea |
| 7 | M, 77 | Nursing home | No witnesses; CPR unknown | Dysphagia after cranial trauma; encephalopathy | <u>Olanzapine</u> : Cardiac blood 322 ng/mL; <u>Amlodipine</u> : Cardiac blood 47 ng/mL | Negative | Subtotal edentulism | Large whitish pasty mass | Epiglottis and laryngeal inlet |
| 8 | F, 62 | Private home | No witnesses; CPR performed | Cirrhosis; overweight | None | 3.5 g/L | Not reported | Two large unchewed meat boluses | Upper airways |
| 9 | F, 59 | Private home | Witnessed; CPR performed | Anxiety disorder; alcohol misuse | <u>Clonazepam</u> : Peripheral blood 24 ng/mL; Liver 18 ng/g; <u>Aminoclonazepam</u> : Peripheral blood 106 ng/mL; Liver 116 ng/g | 1.6 g/L | Not reported | Pasty mass 7×3.5 cm (meat + creamy white material) | Oropharynx; laryngeal inlet; fragments in esophagus, trachea, bronchi |
| 10 | M, 60 | Community lunch | Witnessed; CPR performed | Mild intellectual disability; OCD eating disorder | Multiple benzodiazepines + antipsychotics in Peripheral blood: <u>Desalkylflurazepam</u> ; <u>Hydroxyflurazepam</u> ; <u>Biperiden</u> ; <u>Levomepromazine</u> ; <u>Flurazepam</u> ; <u>Desmethylclozapine</u> ; <u>Delorazepam</u> | Negative | Total edentulism | Creamy kneaded food; vegetable and whitish-protein fragments | Oral cavity; laryngeal inlet; esophagus |
| 11 | M, 29 | Prison | No witnesses; CPR performed | Disorganized schizophrenia | <u>Clozapine</u> ; <u>Clotiapine</u> ; <u>Olanzapine</u> ; <u>Delorazepam</u> ; <u>Lorazepam</u> (all in Peripheral blood) | Negative | Partial edentulism, both arches | Meat piece 10×6 cm, partially removed by paramedics | Oral cavity; supraglottic region; fragments in trachea and bronchi |
| 12 | M, 41 | Psychiatric disability center | Witnessed; CPR unknown | Oligophrenia; cryptogenic epilepsy | <u>Clozapine</u> ; <u>Desmethylclozapine</u> ; <u>Phenobarbital</u> ; <u>Diazepam</u> ; <u>Nordazepam</u> ; <u>Valproic acid</u> (all in Peripheral blood) | Negative | Not reported | Orange slice 8×3 cm + cylindrical meat fragment 7.5×2 cm | Laryngeal inlet; tracheal lumen to right main bronchus |

(continued on next page)

Table 1 (continued)

| Case | Sex, Age | Place of event | Circumstantial data | Medical history | Toxicological findings | Ethanol | Dentition | Food bolus characteristics | Food bolus location |
|------|----------|----------------------|-----------------------------|---|--|------------|---|--|---|
| 13 | F, 68 | Nursing home | No witnesses; CPR performed | Senile dementia; prior cardiac surgery | <u>Chlorpromazine</u> ; Cardiac blood 204 ng/mL; Liver 37 ng/g | Negative | Partial edentulism, both arches | Meat piece 2.5 × 5 cm, likely sausage | Trachea; laryngeal inlet; bronchial fragments |
| 14 | F, 67 | Private home | No witnesses; no CPR | Depression; diabetes; obesity | <u>Haloperidol</u> + <u>Aloxiperidol</u> ; <u>Diazepam</u> ; <u>Nordazepam</u> ; <u>Delorazepam</u> ; <u>Codeine</u> (all in Peripheral blood) | Negative | Total edentulism; severely compromised mastication | Orange fragments (one 8 × 3 cm) + food debris | Larynx and esophagus occluded; plugs in trachea and bronchi |
| 15 | F, 46 | Private home | No witnesses; no CPR | Alcoholism | <u>Oxazepam</u> ; <u>Paracetamol</u> (all in Peripheral blood) | 4.4 g/L | Not reported | Meat and vegetable-mixed material | Oral cavity; laryngeal inlet; piriform recesses; trachea; bronchi |
| 16 | M, 47 | Irrigation canal | No witnesses; no CPR | Degenerative arthropathy; hydatid cyst; alcohol abuse | None | 0.81 g/L | Partial edentulism; maxillary atrophy; severe masticatory deficit | Meat fragment 9.5 × 4.5 cm + gastric content (pasta e fagioli) | Laryngeal inlet; esophagus; trachea; bronchi; stomach |
| 17 | M, 41 | Psychiatric hospital | No witnesses; CPR performed | Chronic psychosis; substance misuse | <u>Promethazine</u> ; Peripheral blood 0.079 µg/mL | 0.13 g/L | Partial edentulism; severe masticatory impairment | Peas + meat fragment 7 × 5 cm + whitish meat fragment | Oral cavity; fauces; larynx; extra-pulmonary bronchi |
| 18 | M, 39 | Private home | No witnesses; CPR performed | Disability; obesity; depressive crises; oligophrenia; sarcophagia | <u>Promethazine</u> metabolites; Urine positivity; <u>Clozapine</u> ; Peripheral blood 0.6 µg/mL; <u>Oxazepam</u> ; Bile positivity | Not tested | Not reported | Not reported | Not reported |

overstimulation, particularly in obstructions located near the laryngeal inlet [1,14]. In our cohort, the presence of multilevel bolus impaction together with autopsy findings consistent with airway obstruction, and the absence of alternative fatal pathological conditions, support a predominantly obstructive mechanism of death. However, as several authors note, reflex-mediated collapse cannot be entirely excluded, particularly in unwitnessed events or in subjects with pre-existing cardiac disease. In the absence of witnessed collapse or real-time monitoring, the distinction between purely obstructive asphyxia and reflex mechanisms remains largely inferential. This limitation is intrinsic to postmortem assessment and reinforces the need for integrating autopsy findings with clinical and scene information.

4.7. Implications for prevention and forensic assessment

The convergence of neurological impairment, psychiatric disease, poor dentition, sedative drugs, and alcohol strongly suggests that fatal bolus airway obstruction is largely preventable. Recent preventive frameworks, particularly those proposed by Saccomanno et al. (2023) [2], emphasize supervised feeding, diet modification, oral health assessment, and drug review for individuals at increased risk. Our findings support these recommendations and suggest that structured risk-stratification protocols could meaningfully reduce incidence.

From a forensic standpoint, our results highlight the importance of a systematic approach that includes thorough airway examination, complete dentition documentation, and comprehensive toxicology. As Byard [13] and Aquila et al. [8] point out, misdiagnosis is possible when obstructive findings are subtle or when toxicological impairment plays a significant but masked role. The clarity provided by integrating all available data is essential not only for determining cause of death but also for understanding contributory conditions with potential legal implications.

4.8. Strengths and limitations

This study offers a uniquely integrated perspective by combining circumstantial reconstruction, autopsy findings, dentition status, and toxicology over a long observational period. However, limitations include its retrospective nature, incomplete dentition data for a minority of cases, and the absence of toxicology in two individuals. Emergency airway manipulation prior to autopsy may also have influenced bolus position in some cases. Moreover, while our sample size is comparable to other single-center forensic studies, larger multi-institutional analyses would allow more robust extrapolation of risk factors and mechanistic patterns.

4.9. Conclusion

Overall, our findings reinforce the concept that fatal FBAO is not merely a matter of inadvertent ingestion of improperly chewed food, but the final expression of a complex, multifactorial process involving impaired neurological or psychiatric status, compromised dentition, sedative drug use, alcohol consumption, and unfavorable circumstantial conditions. Failure to document dentition status and toxicological findings may lead to under-recognition of contributory conditions, with potential medicolegal consequences. A forensic approach that carefully considers all these variables is essential for accurate diagnosis, meaningful prevention, and appropriate medicolegal interpretation.

5. Clinical Trial Number

Clinical trial number: not applicable.

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Author contributions

All authors contributed equally to the conception, drafting, and revision of the manuscript.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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