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# From Abdominal Thrusts to Adaptive Pressure Pulse Systems for Self-Rescue in Foreign-Body Airway Obstruction

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**Abstract:** Foreign-body airway obstruction (FBAO) can deteriorate within minutes and remains an important cause of preventable hypoxic injury. Current first-aid practice relies mainly on back blows and abdominal thrusts, yet the result of these maneuvers may vary with rescuer performance, the timing of intervention, and patient factors. The problem is more difficult when choking occurs without an available bystander. Alongside conventional self-administered maneuvers, suction-based airway clearance devices have therefore attracted attention, although the supporting clinical evidence is still limited. A further concept is to individualize abdominal compression so that the applied pressure is sufficient to generate an expulsive airflow without exposing the patient to avoidable injury. This review discusses current clinical management, the physiological basis and limitations of abdominal thrusts, evidence for emerging self-rescue approaches, and the safety and research requirements of adaptive pressure strategies. At present, these newer approaches should be viewed as investigational or adjunctive rather than replacements for guideline-recommended care.

**Keywords:** Foreign-body airway obstruction; Choking; Abdominal thrusts; Self-rescue; Airway clearance devices; Adaptive pressure

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## 1. Introduction

Foreign-body airway obstruction is a medical emergency in which the interval between obstruction and relief is clinically important. When ventilation is severely compromised, hypoxemia can progress to loss of consciousness, cardiac arrest, neurological injury, and death. Data from the prospective MOCHI registry

have recently quantified this time dependence: longer obstruction duration was associated with progressively worse survival and neurological outcomes, without evidence of a clearly safe period of delay [1]. The practical implication is straightforward—recognition and treatment must occur as early as possible.

Outcome also depends on what happens before professional care is available. In a multicenter prospective study, patients who received a bystander intervention had better one-month survival and neurological outcomes than those who did not [2]. For conscious adults with severe FBAO, the 2025 American Heart Association (AHA) guideline recommends five back blows followed by five abdominal thrusts, repeated until the obstruction is relieved or the patient becomes unresponsive; cardiopulmonary resuscitation is then started [3]. Even so, the evidence supporting individual FBAO maneuvers is less robust than their long clinical history might suggest. A systematic review found very low-certainty evidence across several interventions and also documented procedure-related harm [4].

These limitations are especially relevant to self-rescue. A person with severe choking may be unable to speak, cough effectively, or summon help, and the opportunity for intervention may be brief. Self-administered maneuvers and airway clearance devices have consequently been explored as ways to reduce dependence on an immediately available rescuer. More recently, individualized abdominal compression has been proposed as a possible extension of this idea. The present review examines these developments from a clinical perspective, with emphasis on physiological plausibility, available evidence, safety, and the requirements for future validation.

## 2. Clinical management and physiological basis of abdominal thrusts

The first clinical task is to distinguish severe obstruction from a milder event in which effective coughing is still possible. Features such as an ineffective or absent cough, inability to speak, cyanosis, apnea, or deterioration in consciousness indicate severe FBAO and require immediate action. In adults who remain responsive, current AHA guidance uses alternating sets of five back blows and five abdominal thrusts. Chest thrusts are used when abdominal thrusts are impractical, including late pregnancy or when the rescuer cannot encircle the abdomen; loss of responsiveness changes management to CPR [3]. Although these recommendations provide a clear sequence for practice, the supporting evidence is largely observational [4].

Recent registry data nevertheless support prompt use of conventional maneuvers. In the MOCHI analysis of adults with FBAO, initial bystander abdominal thrusts and back blows were each associated with more favorable neurological outcomes than no bystander intervention [5]. The study does not establish that one technique is superior, because treatment was not randomized and the groups differed in size and clinical circumstances. Its value lies instead in showing that early physical attempts to relieve the obstruction remain relevant in real-world care.

Abdominal thrusts work by converting a brief external compression into a rise in intrathoracic pressure. Compression of the upper abdomen displaces the diaphragm and can produce a short expiratory burst capable of moving an obstructing object toward the mouth. Pavitt and colleagues measured thoracic pressures during abdominal thrusts in healthy volunteers and found that substantial pressures could be generated; whether the thrust was directed upward or circumferentially did not materially change the pressure achieved [6]. This observation suggests that the pressure impulse itself, rather than one exact motion, is central to the maneuver's physiological effect.

The same experiment is also relevant to self-rescue. Self-administered thrusts generated pressures similar to those produced by another person, while forceful compression against a chair back produced still higher values [6]. These findings demonstrate physiological feasibility, not proven treatment efficacy in a choking patient. A higher measured pressure may increase the chance of expulsion, but it may also increase tissue stress. For that reason, any approach intended to reproduce abdominal thrusts should be judged by whether it achieves adequate airway-clearing force without unnecessary compression.

### 3. Limitations of conventional rescue and the clinical need for self-rescue

Manual treatment is simple in concept but variable in practice. Recognition can be delayed, hand position may be inaccurate, and the force delivered depends on the rescuer's strength and confidence. Patient condition also differs widely. In a prehospital series of 513 adults with FBAO, the mean age was 65 years, and older age together with abnormal initial vital signs was associated with poorer outcome [7]. Such findings are important because many choking events occur in people whose physiological reserve is already limited.

The population at risk is not homogeneous. Neurological disease, dysphagia, and dental problems are repeatedly identified as major contributors to choking risk [8]. Frailty, restricted mobility, obesity, or difficulty cooperating with a rescuer can further complicate abdominal thrusts. These factors do not prove that a specific force should be used for a specific body type, but they make a universal mechanical response clinically difficult to justify.

Injury is another consideration. Abdominal thrusts are lifesaving when indicated, yet complications have included gastric or esophageal injury, rib fractures, vascular trauma, and pancreatic damage. Lee and colleagues reviewed reported complications of the Heimlich maneuver and stressed the need to evaluate patients who remain symptomatic after successful relief of the obstruction [9]. The appropriate conclusion is not to avoid abdominal thrusts, but to recognize that greater force is not automatically better.

Self-rescue becomes relevant when the usual rescuer-patient relationship is absent. Severe obstruction may quickly impair speech, purposeful movement, and consciousness, so waiting for another person may consume a substantial part of the available time. A useful self-rescue method would therefore need to be accessible, easy to initiate under stress, and capable of producing an effective expulsive effort without exposing the user to uncontrolled or repeated compression. This clinical requirement, rather than technical novelty alone, is the strongest rationale for developing alternative approaches.

## 4. Emerging approaches for FBAO self-rescue

One group of newer interventions uses suction rather than external compression. These airway clearance devices are designed to create negative pressure through a mask or oral interface and thereby draw the obstructing material proximally. Their appeal is obvious in a situation where manual maneuvers have failed or no trained bystander is present, but the evidence base has developed more slowly than their public visibility. A 2020 systematic review found that the literature was dominated by case reports, case series, and limited observational evidence, and concluded that suction devices could not be recommended as replacements for established FBAO care [10].

Subsequent studies have added useful real-world data. In an independent two-year prospective evaluation, 186 device-use events were reported, and obstruction relief frequently followed device application [11]. Interpretation remained difficult because standard basic life support measures had often been

attempted first and the observational design could not fully determine causality or adverse-event attribution. A 2025 systematic review reached a similarly cautious position: results were promising, but heterogeneity, training requirements, and methodological limitations prevented firm conclusions about comparative effectiveness [12]. At present, suction devices are best considered an adjunctive or investigational option rather than an evidence-based substitute for guideline-directed maneuvers.

A different line of development is to retain the physiological principle of abdominal thrusts while making compression more reproducible and more responsive to the patient. In clinical terms, an adaptive pressure strategy would mean adjusting compression intensity according to relevant anatomical or physiological characteristics instead of delivering the same output to every individual. Age, body size, abdominal habitus, posture, and tolerance could all influence the balance between an adequate expulsive effect and injury risk. The concept is therefore less about maximizing force than about finding an effective range of compression for the person being treated.

Pressure or physiological feedback might eventually help determine whether another compression is needed, but this remains a hypothesis rather than established practice. Any proposed system would need to show that added complexity improves a clinically meaningful endpoint—such as faster obstruction relief or fewer injuries—rather than merely producing more precise mechanical measurements. That distinction is important if self-rescue technology is to remain clinically driven.

## 5. Safety, clinical evidence and future perspectives

Safety is inseparable from efficacy in FBAO management. Conventional abdominal thrusts have a recognized, although uncommon, potential for serious injury [9]. Newer device-assisted approaches introduce additional questions: whether the intervention can be applied incorrectly, whether an ineffective attempt delays established treatment, and whether the user can recognize failure quickly enough to escalate care. The 2025 AHA guideline states that the effectiveness and safety of suction-based airway clearance devices in adults with FBAO have not been established and that the available evidence is insufficient for a recommendation [3].

The main weakness of the literature is not a lack of reported successes but a lack of strong comparison. Systematic reviews have repeatedly identified reliance on case reports, simulations, and observational series, with substantial risk of bias and few direct comparisons with standard maneuvers [4,10,12]. A 2026 systematic review and meta-analysis pooled six studies involving 789 participants or simulated events and reported a high overall clearance rate for antichoking suction devices, but heterogeneity and possible publication bias were considerable [13]. Device-level clearance should therefore not be treated as equivalent to improved survival, neurological recovery, or safety.

Future studies should use outcomes that matter to patients and emergency systems. Time to relief, need for repeated attempts, survival, neurological status, complications, and failure requiring professional airway management are more informative than technical success alone. Independent multicenter studies are particularly important. Special populations also need focused evaluation because late pregnancy, frailty, obesity, and advanced age may alter both the feasibility and the risk of abdominal compression [3,8].

Adaptive pressure strategies face the same evidentiary standard. Their clinical value would depend on showing that individualized compression can preserve or improve airway clearance while limiting trauma.

Feedback based on pressure or simple physiological signals may be useful, but it should be added only when it changes decision-making or patient outcome. For the foreseeable future, innovation in FBAO self-rescue should complement—not outrun—the evidence supporting established first-aid care.

## 6. Conclusion

Foreign-body airway obstruction demands rapid action, and back blows with abdominal thrusts remain the foundation of first-aid treatment for severe adult FBAO. Their limitations are most apparent when no rescuer is present, when patient characteristics make manual treatment difficult, or when repeated force raises concern for injury. Suction-based devices and individualized abdominal pressure approaches offer possible routes toward self-rescue, but neither has sufficient evidence to replace standard care. Future progress should be judged by clinically meaningful outcomes, safety, and independent prospective validation. Adaptive pressure may become useful if it can provide effective compression without unnecessary trauma, but that premise still requires direct clinical testing.

## Disclosure statement

The authors declare no conflict of interest.

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