



Original Contribution

Effectiveness of glucagon in relieving esophageal foreign body impaction: a multicenter study ☆☆☆



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ABSTRACT

Purpose: Glucagon is thought to decrease lower esophageal sphincter tone and is used as an alternative to invasive endoscopy for esophageal foreign body impaction (EFBI). The purpose of this study was to evaluate efficacy and safety of glucagon and identify characteristics associated with success.

Methods: A multicenter, retrospective study of patients receiving glucagon for EFBI at 2 academic emergency departments was conducted between 2006 and 2010. A control group of patients that did not receive glucagon was evaluated. Data collection included demographics, type of foreign body, glucagon dose, resolution of impaction, incidence of vomiting, additional medication, and endoscopy required. Descriptive and univariate analysis was performed as appropriate.

Results: A total of 133 doses of glucagon were administered in 127 patients. Glucagon-related resolution of EFBI occurred in 18 patients (14.2%) and vomiting in 16 patients (12.6%). No statistical differences between successful and unsuccessful groups were seen with the exception of concomitant medication administration (benzodiazepine or nitroglycerin) being associated with less glucagon success, 33.3% vs 59.6%, respectively ($P = .04$). Eighty-four percent of patients in the unsuccessful group underwent endoscopy. Comparing those that received glucagon ($n = 127$) and the control group ($n = 29$), there was no significant difference in resolution of EFBI, 14.2% vs 10.3%, respectively ($P = .586$).

Conclusions: Glucagon-related resolution occurred in 14.2% of patients and was not significantly different compared with those that did not receive glucagon (10.3%). Concomitant medication administration was associated with lower success. Overall, glucagon had a low success rate, was related to adverse effects, and does not offer advantages for treatment.

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1. Introduction

Acute esophageal foreign body impactions (EFBIs) are a relatively rare chief concern in the emergency department (ED); however, the complications to patients can be devastating and costly. An esophageal foreign body can cause abrasions, punctures, and perforations, with resultant injuries and infection to surrounding structures. These can include abscesses, pneumomediastinum, mediastinitis, pneumothorax, pericarditis, cardiac tamponade, fistulas, aspiration pneumonia, and vascular injuries to the aorta or pulmonary vessels. Button battery impaction, in particular, can rapidly cause esophageal necrosis. Therefore,

timely treatment is paramount to help mitigate subsequent morbidity and health care costs.

Indications for expectant management include a patent airway and the ability to clear secretions. In many cases, patients may experience significant pain, which heightens the need for early intervention to dislodge the foreign body. Endoscopy with direct visualization and removal of the object or aiding in its distal progression into the stomach is the criterion standard and preferred definitive therapy. This procedure is invasive, expensive, and time consuming because it requires the involvement of a consultant who often may not be on-site, requires procedural sedation, and is not without its own significant risks and complications (eg, esophageal perforation, aspiration, apnea, hypoxia). Therefore, the ideal treatment modality in this clinical scenario would be one that worked rapidly, is noninvasive, and has a low risk of complications.

Many physicians choose to apply one of several less invasive modes of therapy before considering endoscopy. A nonpharmacologic

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treatment option that has been shown to be the most effective nonendoscopic treatment modality is the administration of carbonated beverages which is inexpensive, is safe, and has an average success rate of 79% [1]. Pharmacologic agents that have been described for this purpose include nifedipine, sublingual nitroglycerin, proteolytic enzymes, benzodiazepines, and the most frequently implemented therapy, glucagon [2]. Glucagon, first proposed in 1977, has been shown to decrease lower esophageal sphincter tone by causing smooth muscle relaxation [3,4]. Based on this mechanism of action, glucagon has become one of the most widely accepted, first-line agents for EFBI in the ED despite the fact that the literature supporting its use is controversial and of poor quality [5]. Currently, only 6 studies exist in the medical literature evaluating the efficacy of this therapy despite its widespread use. Of these, only 2 have actually investigated glucagon therapy alone [5]. Glucagon generally has few adverse effects, which may contribute to its popularity, most commonly nausea and vomiting. Consequently, these adverse effects may contribute to the anecdotal success of this agent by causing dislodgement of the foreign body. However, symptom resolution via this mechanism carries with it a significant risk of aspiration. The cost of glucagon is also not inconsequential, as the Average Wholesale Price at the time of publication is approximately \$206 for 1 mg. Although this cost is significantly less than that of endoscopy, if it is ineffective or results in aspiration, then this further compounds both the expense and complexity of this clinical scenario.

The purpose of this study was to evaluate the efficacy of glucagon for the resolution of EFBI at 2 large academic EDs. We also hoped to explore the adverse effect profile of this agent in this setting to better clarify the risk-benefit ratio of its use in this scenario. In addition, we sought to evaluate the characteristics associated with the successful use of glucagon for this indication.

2. Materials and methods

2.1. Study design

This was a retrospective, observational study of patients who received glucagon for EFBI in 2 academic EDs ($n = 127$). A small control group of EFBI that did not receive glucagon was also included for comparison ($n = 29$). Approval for this study was obtained from the institutional review boards at both institutions.

2.2. Study setting and population

This study was conducted in 2 academic EDs. The University of Rochester Medical Center (URMC) and University of Kentucky Medical Center (UK) are 739-bed and 745-bed university teaching hospitals, respectively at the time of this study. Data were collected from May 2006 through July 2010 at URMC and January 2007 through December 2009 at UK. Patients were captured by retrospective review of automated dispensing cabinet reports and *International Classification of Diseases, Ninth Revision*, codes (ie, 935.1, 938, 530.3, E912, E915) to identify those that received glucagon or presented with EFBI in the EDs. All adult and pediatric patients presenting to the ED that received glucagon for an EFBI were included. Both the administration of glucagon and the indication for its use in EFBI were confirmed by review of medical records. There were no additional exclusion criteria.

2.3. Study protocol

A complete medical record review was conducted by 1 abstractor at each institution using a standardized abstraction form and code book to gather demographics including age, sex, type of foreign body ingested, glucagon dose administered, incidence of resolution of the EFBI, time to resolution, incidence of vomiting, time from glucagon administration to vomiting, and known patient esophageal abnormalities. Additional medications given for EFBI (ie, benzodiazepines, nitroglycerin), the

need for endoscopy, and endoscopy-related adverse effects were collected. *Glucagon efficacy* was defined as documented resolution of symptoms within 60 minutes from administration. Sixty minutes was chosen based on the peak effect of glucagon, the published duration of glucagon-induced lower esophageal sphincter relaxation, and use of this time frame in the only available randomized controlled trial [3,6,7]. Patients that were administered glucagon and vomited within 60 minutes were not deemed successful because this is not the proposed mechanism of glucagon for relief of EFBI. After patients were determined to have had successful or unsuccessful resolution of symptoms with glucagon, these 2 groups were further analyzed to attempt to describe characteristics associated with glucagon success. Also, success of EFBI relief with glucagon was compared with a small group of EFBI patients that did not receive glucagon. *Spontaneous resolution* in the patients that did not receive glucagon or any pharmacologic therapy was defined as self-reported resolution of symptoms at any point during the ED visit.

2.4. Data analysis

Descriptive analyses were performed for all variables collected. Associations between continuous and categorical variable were assessed using Wilcoxon rank sum and Fisher exact analysis, respectively. Statistical significance was defined as a 2-tailed P value $\leq .05$.

3. Results

A total of 127 patients that received intravenous or intramuscular glucagon for the indication of EFBI between May 2006 and July 2010 at URMC and January 2007 and December 2009 at UK were included in this review. There were 85 males (66.9%), and the median age of the patients was 35.5 years (range, 2–89 years). The most common types of foreign body impaction were food (89%) and coins (8%). Esophageal abnormalities were present in 22 patients (17.3%).

There were 133 doses of glucagon administered, and the median glucagon dose was 1 mg (interquartile range, 1–1 mg). Glucagon was successful in the resolution of EFBI symptoms in 18 patients (14.2%). Four patients received 2 sequential doses of glucagon and 1 patient received 3 sequential doses of glucagon without success. Overall, vomiting occurred in 16 patients (12.6%). A total of 73 patients (57.5%) received an additional medication for EFBI (ie, benzodiazepines, nitroglycerin). Five patients received more than 1 concomitant medication in addition to glucagon. Timing of benzodiazepine and nitroglycerin administration compared with glucagon varied greatly, with 46.2%, 34.6%, and 19.2% of doses occurring before, after, or simultaneously with glucagon, respectively. However, only 6 patients that received glucagon and another medication had glucagon-related EFBI symptom resolution. Endoscopy was required in 92 patients (84.4%) that did not have glucagon-related success. A superficial esophageal laceration was reported during the procedure in 1 patient. No major adverse events were noted with the endoscopy procedure.

Analysis was performed to assess the characteristics associated with glucagon-related success (Table 1). Comparisons between the successful and unsuccessful groups did not reveal any statistical differences with the exception of concomitant medication administration.

Table 1
Comparisons between glucagon-related successful and unsuccessful groups

| Characteristics | Successful ($n = 18$) | Unsuccessful ($n = 109$) | P value |
|------------------------------------|----------------------------|-------------------------------|------------------|
| Median age, y (range) | 45 (12–67) | 34.5 (2.1–89) | .30 ^a |
| Sex, no. male (%) | 12 (66.7) | 73 (67.0) | .98 ^b |
| Type of foreign body, no. food (%) | 18 (100) | 95 (87.2) | .11 ^b |
| Esophageal abnormality, no. (%) | 1 (5.6) | 21 (11.0) | .15 ^b |
| Concomitant medications, no. (%) | 6 (33.3) | 65 (59.6) | .04 ^b |

^a Wilcoxon rank sum.

^b Fisher exact test.

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