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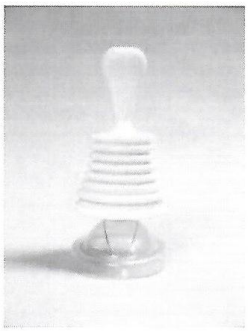
Correspondence

Assessment of the LifeVac, an anti-choking device, on a human cadaver with complete airway obstruction



We performed an independent study to determine whether the anti-choking device, LifeVac, is capable of removing a food bolus from an obstructed airway when the potential for choking as a medical emergency exists.

The LifeVac is a non-powered, single patient, portable suction apparatus (anti-choking device) developed for resuscitating choking victims when standard current choking protocol has been followed without success. The LifeVac is designed with a patented valve to prevent air from exiting through the mask. This patented valve is designed to prevent the strong pulse of air from pushing food or objects further downward, lodging the blockage deeper into the airway of the victim. A one-way suction stream is thus created to remove the lodged food or object. The negative pressure generated by the force of the suction is 3 times greater than the highest recorded choke pressure. The mean peak airway pressure with abdominal thrusts is 26.4 ± 19.8 cmH20 and with chest compressions, 40.8 ± 16.4 cmH20, respectively ($P = .005$, 95% confidence interval for the mean difference 5.3–23.4 cmH20.) The LifeVac generates over 300 millimeters of mercury (mm Hg) of suction.

Each year, approximately 3000–4000 Americans die from choking. Children and the elderly present much higher risks for choking. At least one child dies from choking on food every five days in the U.S., and more than 10,000 children are taken to hospital emergency departments each year for food-choking incidents. Semisolid foods are the major cause of a large number of asphyxiations, especially among the elderly.

This study was conducted at Fusion Solutions, a cadaver based training center in New York. An unselected, recently diseased individual was employed in the study. The subject was a 71 year old, Caucasian female, 153 pounds, 65 inches with a Body Mass Index of 25. Medical history was remarkable for breast cancer.

The paramedic technician placed a simulated food bolus 7 to 10 centimeters into the subject's upper airway. The obstruction was visually and verbally confirmed prior to use of the LifeVac apparatus. Three simulated boli obstructions made of clay were used: a 2 cm (small), a 2 1/2 cm (medium) and a 3 cm (large) size. The simulated boli were attached to a string to maintain control during the study.

The paramedic technician placed an adult LifeVac mask on the cadaver following operating guidelines to remove the lodged bolus. The author observed and recorded the success rate. It was noted on one trial that a second pull was required to ensure a tighter seal following an initial failed trial. This achieved increased suction and ensured removal of the simulated bolus. The LifeVac removed the bolus successfully 49/50 trials on the first trial.

The American Red Cross' recent first-aid protocol de-emphasizes the use of the Heimlich for treating a conscious choking victim. The new

Figure 1. Placement of large simulated bolus (3 cm) 7-10 centimeters past tongue base into upper airway of subject.

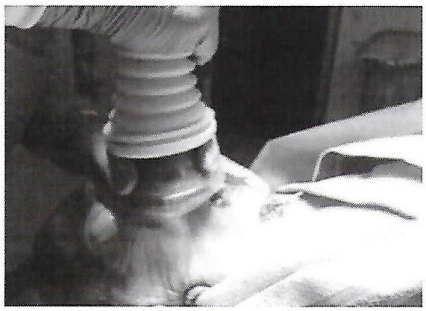


Figure 2. Placement of LifeVac device on the cadaver using guideline protocol to achieve proper seal to operate device.

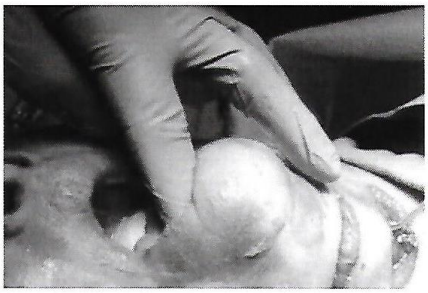


Figure 3. Picture of large simulated bolus (3 cm) lifted from airway.

protocol recommends calling 9–1-1, then giving the person several sharp blows to the back, right between the shoulder blades, with the heel of the hand. If this doesn't clear the obstructed airway, "abdominal thrusts" should be tried next, alternating with repeated back blows, until the person breathes freely or loses consciousness.

According to Langhelle et al., standard chest compressions are more effective than the Heimlich maneuver for treating complete airway obstruction by a foreign body.

The Heimlich maneuver on a frail individual who is in a wheelchair can be difficult to administer expediently. Complications include rib fractures, gastric or esophagus perforations, aortic valve cusp rupture, diaphragmatic herniation, jejunum perforation, hepatic rupture, mesenteric laceration. There has also been a new case of fatal hemoperitoneum due to hilar laceration of the spleen.

When treating a choking child, John Hopkins School of Medicine warns, " When applying the Heimlich maneuver, be careful not to use too much force so you don't damage the ribs or internal organs."

Choking is a medical emergency that warrants prompt, precise action by anyone available. This results of this study revealed that the LifeVac was able to clear a completely obstructed upper airway. Given the potentially life-or-death nature of given situations, the LifeVac is deemed to be a clinically effective alternative to current emergency protocol to save choking victims. Hence, the LifeVac can be utilized as a safe, simple and effective method to use in critical situations.

Speech Pathologists treat swallowing disorders. Dysphagia treatment consists of teaching compensatory strategies, aspiration precautions, appropriate diet and caregiver training to prevent risks for aspiration. The LifeVac is non invasive and can be used by anyone, both medical personnel and laypersons alike. Results of this study suggest that the LifeVac can be included as part of the guidelines used for basic life support management of choking victims.

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LifeVac submission in the AJG (American Journal of Gastroenterology)
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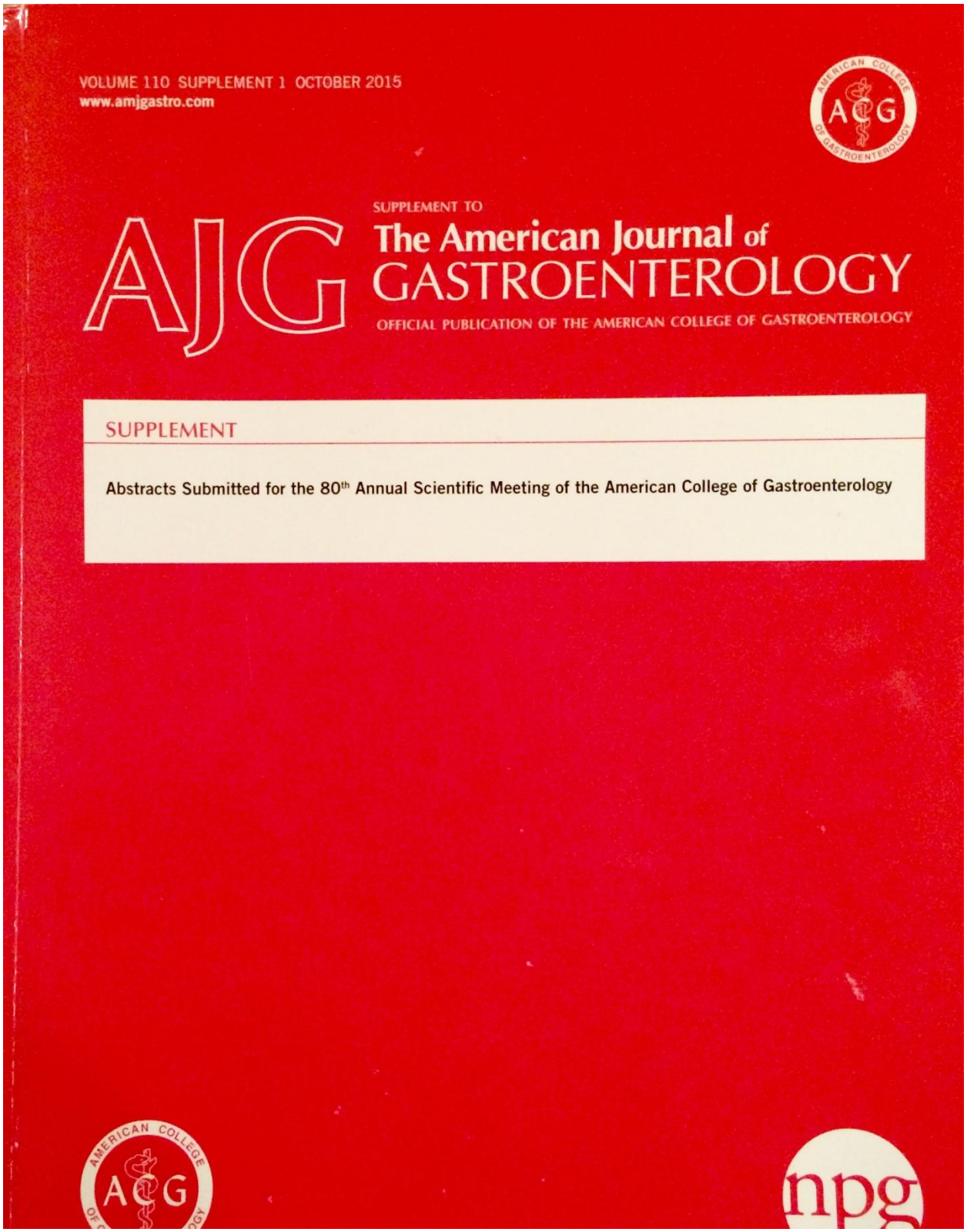
Section #1624



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of effect measure (odds or risk ratio), was original, used the individual as the unit of analysis and published after 2000. Each study was weighted according to its inverse variance. The distribution of effect measures were examined using visual and tabular displays as well as tests of homogeneity to reveal variation in the risk estimates of histologic BE occurrence between AA and nHw using a DerSimonian-Laird random-effects method. Odds ratio was calculated along with 95% confidence interval estimates. Forest plots were conducted and summary odds ratio with 95% CI of histologic BE was reported. Heterogeneity was quantified using the I2 statistic. A sensitivity analysis was performed comparing results with and without case control studies. Software used to conduct the meta-analysis was the open source OpenMetaAnalyst platform.

Results: A total of 8 eligible studies reporting histologic confirmation of BE in either AA or nHw. Analysis including the case control study demonstrated a nearly 400% increased risk for nHw patients having histologic BE compared to AA (OR 3.949, 95% CI 3.069-5.082, figure 1). In the random effects model without the case control study, the risk of histologic BE remained elevated at approximately 360% in nHw compared to AA (OR 3.618, 95% CI 2.769-4.726, figure 2). Heterogeneity was not present in either model (case control included I2=17%, p=0.296, figure 1; without case control I2=0%, p=0.42, figure 2).

Conclusion: In a meta-analysis of studies that examined histologic confirmation of BE between AA and nHw, we observed that nHw had a risk of histologic BE between 3.6 and 4 times higher than AA. Investigation into understanding any molecular/genetic mechanisms underlying this risk disparity is warranted.

1624

LifeVac: A Novel Apparatus to Resuscitate a Choking Victim

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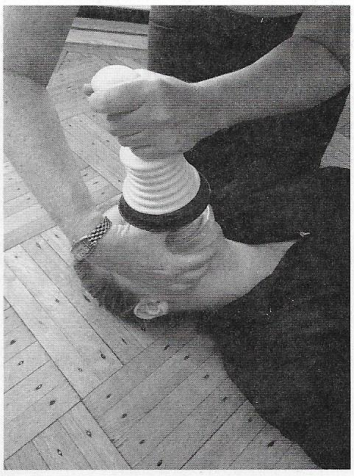
Introduction: Patients with oropharyngeal dysphagia are at increased risk for choking which can be a leading cause of death in this population. Currently there are no methods to remove an inhaled object if the traditional Heimlich maneuver fails. We have developed an apparatus which is simple to use in order to remove an object lodged in the upper airway if the Heimlich maneuver fails.

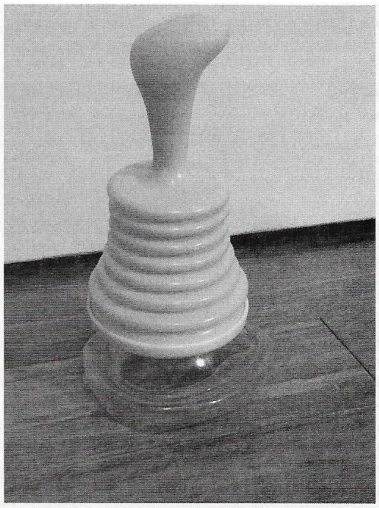
Methods: The Laerdaltm Choking Charlie simulator system designed specifically for training for the Heimlich abdominal thrust maneuver was used in order to simulate a choking victim. A Nathans Cocktail Frank cut in half was utilized as this food is responsible for many choking deaths. The item was pushed into the airway 7 cm from the lips in order to create an obstruction in the airway. The Lifevac unit was then utilized per the products instruction manual to attempt to dislodge the object and the frequency of dislodging the object was recorded.

Results: Using Laerdal Choking Charlie with a hot dog piece inserted into the airway the Lifevac successfully removed the object 470 out of 500 attempts in one useage, in 498 out of 500 attempts with two useages, and was successful 500 out of 500 attempts in three useages. The 95% confidence interval for the probability of success (S) of the device (when defining success as removal in one usage) = 91.5% < S < 95.9%. The 95% confidence interval for the probability of success (S) of the device (when defining success as removal in two or fewer usages) = 98.5% < S < 99.9%.

Conclusion: Lifevac is a promising apparatus that is simple to use and appears to be an extremely effective method in successfully dislodging an object lodged in the ariway of a choking victim. Further studies with cadavers and subsequent pilot studies in humans are warranted in the hopes of saving lives when the Heimlich maneuver fails.



[1624A] Figure 1.



[1625B] Figure 2.

1625

Lower Oropharyngeal Acid Exposure and Higher Psychological Distress Exists Amongst Subjects With Laryngeal Symptoms and Response to PPI Therapy

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Introduction: Predicting therapeutic response in patients with laryngopharyngeal reflux (LPR) symptoms is challenging. Consequently, patients with suspected LPR often receive empiric proton-pump inhibitor (PPI) therapy and up to 50% may not respond. The Restech Dx-pH probe is a transnasal catheter that measures oropharyngeal pH. We hypothesized that higher oropharyngeal acid burden is associated with a greater PPI response. The aims of this study were to (1) correlate oropharyngeal pH probe parameters with PPI response and (2) evaluate if alternative clinical surrogates predict PPI response.

Methods: This was a physician blinded prospective cohort study conducted at a tertiary care teaching institution between 1/2013 and 10/2014. Adult subjects with laryngeal symptoms >1 month and a Reflux Symptom Index score (RSI) ≥13 off PPI therapy 2 weeks prior to study were recruited from an otolaryngology clinic. Laryngoscopy and oropharyngeal pH assessment with the Restech Dx-pH system were first performed, followed by an 8 to 12 week trial of omeprazole 40 mg once daily. Prior to, and following PPI therapy, subjects completed various symptom questionnaires [Table 1]. PPI response was defined as > mean delta RSI (difference between pre- and post-PPI therapy RSI).

Results: Of 34 subjects, 15 (44%) had a PPI response. Percent time of oropharyngeal pH below 5.0 did not correlate with change in RSI (Spearman's rho -0.07, P=0.7); similar trends were seen for pH < 4.0, 5.5 & 6.0. Low acid exposure (< 1%) was significantly associated with PPI response when compared to high acid exposure (≥1%) [Figure 2]. PPI responders had higher psychological distress scores prior to treatment and a significantly greater reduction in post-treatment Brief Symptom Index, Negative Affect, and Heartburn Vigilance Scale scores. Baseline and delta GerdQ scores were significantly higher in the PPI responder group.

Conclusion: Contrary to our hypothesis, low oropharyngeal acid burden was associated with PPI symptom response, suggesting a non-acid mechanism of laryngeal symptoms in this group. PPI responders had higher psychological distress, indicating an association between cognitive affective symptoms and laryngeal complaints and supporting the placebo effect of PPI therapy. The etiology of laryngeal symptoms is undoubtedly complex, and the role of oropharyngeal pH testing to predict PPI response remains unclear.

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Interference With Daily Activities and Major Adverse Events During Esophageal pH Monitoring With Bravo® Wireless Capsule Versus Conventional Intranasal Catheter: A Systematic Review of Randomized Controlled Trials

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Introduction: For three decades, ambulatory 24-hour intranasal pH monitoring has been the established gold standard for detecting acid reflux in patients with refractory gastroesophageal reflux disease. However, device-associated adverse events and unpleasant experiences, reported by patients