Hemorrhagic Pulmonary Edema Associated with Meat Tenderizer Treatment for Esophageal Meat Impaction*

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We describe a case of acute hemorrhagic pulmonary edema caused by aspiration of Adolph’s meat tenderizer, used in an attempt to relieve an esophageal meat impaction. We performed an animal experiment in which bronchial instillation of a similar solution reproduced the clinical findings in our patient. This is a previously unreported and potentially lethal complication of a therapy that has never been submitted to clinical trials. We recommend against the use of this therapy for patients with complete esophageal obstruction or in those otherwise at risk for aspiration.

(Chest 1988; 94:640-42)

Esophageal obstruction following ingestion of a large bolus of food is a common clinical problem. Partial or complete obstruction tends to occur in individuals with a defect in chewing, esophageal patency, or cognitive function. Presenting complaints include rapid regurgitation of most or all ingestants, excessive salivation with coughing and choking, pain approximating the area of obstruction, and inability to vomit. In 1945, Richardson1 reported successful use of the proteolytic enzyme papain (the dried and purified latex of the fruit Carica papaya) in 17 patients who presented with esophageal meat obstruction. Before that time, standard therapy had been strictly mechanical: attempts were made to force the bolus into the stomach, or esophagoscopy was performed for piecemeal removal of the impaction. Currently, papain treatment for meat impaction of the esophagus is an accepted therapy for use before attempting mechanical measures.2 4 We report a case in which inadvertent aspiration of the papain caused life-threatening hemorrhagic pulmonary edema, and present data from a preliminary animal study confirming this association.

CASE REPORT

A 14-year-old boy was brought to the emergency room complaining of dysphagia and inability to vomit following an attempted three-bite pork chop ingestion. His past medical history was significant only for asthma, which had required intermittent therapy with bronchodilators. He had normal exercise tolerance and normal growth and development. There was no past history of esophageal dysfunction. Physical examination results were within normal limits except for the presence of excessive salivation. The impacted bolus could not be visualized in the hypopharynx. His chest was clear to percussion and auscultation. A barium esophagogram demonstrated complete obstruction at the level of the gastroesophageal junction (Fig 1). Following the esophagogram, the patient was given sips of a solution consisting of one rounded teaspoon of Adolph’s meat tenderizer dissolved in 240 ml of water. When the obstruction was not relieved after 30 min, the patient was also given meperidine, 25 mg IM, diazepam, 5 mg IV, and glucagon, 0.5 mg IV, in an attempt to promote esophageal relaxation. Three hours later, the obstruction was still present. Bouginage was attempted but was likewise unsuccessful, so the patient was taken to the operating room for esophagoscopy. He was alert but quite drowsy. He underwent endotracheal intubation without clinical suspicion of aspiration and rigid esophagoscopy in the supine position. The obstruction was relieved after piecemeal removal. There was no evidence of esophageal trauma. During the procedure, the patient developed severe respiratory distress. Rales and wheezes were heard in the right chest. Arterial blood gas analysis, measured while he was breathing room air, showed: pH, 7.21; PaCO₂, 62 mm Hg; PaO₂, 39 mm Hg; and HCO₃, 28 mEq/dl. A chest x-ray film demonstrated diffuse alveolar infiltrates throughout the right lung (Fig 2).

An emergency bronchoscopic examination failed to reveal the presence of any foreign body, but was remarkable for severe airway inflammation and a massive volume of hemorrhagic pulmonary edema fluid emanating from the right side of the tracheobronchial tree. The left side appeared normal. The patient was treated with

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steroids, antibiotics, and bronchodilators and was maintained on a mechanical ventilator with 10 cm H2O positive end-expiratory pressure and an FiO2 of 1.0 to achieve a PaO2 of 80 to 90 mm Hg. Eight hours later, his chest x-ray film and gas exchange were unimproved. However, 18 h after the esophagoscopy, arterial blood gas values and chest x-ray film began to improve rapidly, and the patient was extubated 36 h following the presumed aspiration. A chest x-ray film taken just before extubation showed complete resolution of the pulmonary infiltrates (Fig 3). Pulmonary function studies obtained two weeks later showed a forced vital capacity of 3.23 L (85 percent predicted), FEV1 of 1.88 L (54 percent of predicted), FEF25-75% of 0.63 L (28 percent of predicted), and a diffusing capacity of 17.9 ml/min/mm Hg (69 percent of predicted).

**Animal Study**

An anesthetized 25-kg open-chest dog was selectively intubated with a double-lumen endotracheal tube. A catheter was passed to the right lower lobe bronchus, and 60 ml of water containing 1 tsp of Adolph’s meat tenderizer was injected. This dose was chosen because it is in the middle range of concentration recommended for use in meat impaction.\(^2\)\(^5\) In addition, it would be possible using multiple sips, to accumulate a volume as high as 60 ml in the

![FIGURE 2. Perioperative chest x-ray film showing diffuse alveolar infiltrates throughout the right lung field.](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21583/)

![FIGURE 3. Chest x-ray film 36 h after aspiration showing marked improvement.](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21583/)

![FIGURE 4. Cut gross specimen of dog lung showing consolidation, frothy pulmonary edema fluid in airway, and subpleural hemorrhage.](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21583/)
esophagus proximal to a complete obstruction, thus making this quantity available for potential aspiration.

RESULTS

Within 5 min of instillation of the solution, the animal developed frothy hemorrhagic pulmonary edema that reached a total volume of 400 ml in 20 min. Over this time, the lobe underwent rapid loss of volume and increase in weight, with marked subpleural hemorrhage (Fig 4). The dog was sacrificed following a lethal injection of thiopental sodium (Pentothal). Histologic sections showed consolidation and hemorrhagic pulmonary edema without inflammatory infiltrate.

DISCUSSION

Since the original report by Richardson, papain has been recommended as a possible therapy for meat impaction of the esophagus, even though, as pointed out by Cavo et al, no clinical trials evaluating the various regimens have been carried out. Complications associated with the use of this agent have included esophageal perforation and severe hyperosmolarity in a woman given Adolph's meat tenderizer for therapy of a bezoar. Tarlo et al and Flindt have noted allergic bronchoplastic reactions in factory workers repeatedly exposed to papain powder. Hemorrhagic pulmonary edema has not been reported, to our knowledge. However, it might be reasoned that it could occur, based on the animal experiments performed by Andersen et al: 17 dogs were given various papain solutions following placement of meat in the esophagus in an attempt to determine whether esophageal perforation would occur. None of the dogs developed this complication; however, all of them developed moderately severe to fatal hemorrhagic pulmonary edema. The authors concluded that the most likely cause was aspiration complicating general anesthesia. Patients with complete esophageal obstruction and any cause for altered mental state, such as ingestion of sedatives or alcohol or chronic dementia, are at similar risk. We feel our patient aspirated the papain solution and not gastric contents because initially his esophagus was completely blocked by the meat, and during removal of the impaction, his tracheobronchial tree was protected by a cuffed endotracheal tube.

Papain may also have long-term effects on the lung, as evidenced by animal studies in which various regimens of inhaled aerosolized papain were used to produce an experimental model of emphysema. Fortunately, our patient's pulmonary edema resolved quickly, but his decreased diffusing capacity is not explained by his coexistent asthma. If the course of this lung injury follows a pattern similar to that seen following the adult respiratory distress syndrome, resolution may eventually occur. However, the possibility also exists that he has already suffered some enzyme-related loss of lung parenchyma.

While the patient has done well clinically, papain aspiration and resultant hemorrhagic pulmonary edema is a potentially lethal complication of the use of Adolph's for relief of esophageal meat impaction. The long-term effects of this complication are at present unknown but may include emphysema. We believe that the use of this therapy should be discouraged if there is any question about a patient's ability to protect his airway, if there is concomitant use of sedatives or narcotics, or in the presence of complete esophageal obstruction leading to pooling of secretions in the proximal esophagus.

ACKNOWLEDGMENTS: The authors wish to thank Dr. John Butler for encouragement and the use of his laboratory: Wayne Kirk for assistance with the animal experiment; Dr. Michael Grabowski, Dr. Gerald Garrett, and Mr. Paul Anderson, R.Ph., for technical assistance; Dr. Claire Miller for allowing us to study her patient; Drs. Charles Pope, John Butler, David Pierson, Leonard Hudson, Bruce Culver, H. Thomas Robertson, and Robert Seale for review of the manuscript, and Barbara Geffert, medical transcriptionist.

REFERENCES