

Upper Aerodigestive Injuries From Detergent Ingestion in Children

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Objectives: To describe the clinical presentations and management of detergent pod ingestion at a tertiary children's hospital.

Study Design: Case series.

Methods: A retrospective chart review of children diagnosed with detergent pod ingestion from June 2010 and March 2015.

Results: Nine cases of detergent pod ingestion were included over a 5-year period. The average age was 26.3 months (range, 11–43 months). Eight (89%) of the cases were female. The patients had ingested laundry detergent pods (n = 7) and dishwasher detergent pods (n = 2). The majority of patients (67%) had more than one clinical manifestation from ingestion. Presenting symptoms included emesis (78%), respiratory symptoms (56%), throat pain (22%), drooling (33%), and foaming at the mouth (33%). The management of patients depended on the severity of their symptoms and included admission to an overnight observation unit (n = 5), discharge to home directly from the emergency department (n = 2), and admission to the hospital (n = 2). Two (22%) children underwent esophagogastroduodenoscopy. One child (11%) required intubation from bilateral vocal fold immobility.

Conclusion: Injuries to the upper aerodigestive tract after detergent ingestion range from mild gastrointestinal symptoms to respiratory compromise. The majority of children improve with observation alone; however, clinicians should maintain a low threshold for endoscopic evaluation in cases of severe symptoms and airway involvement.

Key Words: Detergent, pod, capsule, laundry, dishwasher, ingestion.

Level of Evidence: 4.

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INTRODUCTION

Accidental ingestion is a common cause of preventable morbidity in children. Detergents are among the most common source of accidental ingestion in children younger than 6 years of age in the United States.^{1,2} Laundry detergent pods were introduced into the U.S. market in 2010 and had been available in Europe that previous decade. These single-use pods contain concentrated detergent in a water-soluble membrane. They have been cited as an increasingly common cause of accidental ingestion in young children due to their resemblance to brightly colored candy.³

Laundry detergent pod exposures among children increased by 600% from March 2012 to April 2013 and included 17,230 cases in this period, as reported by the United States Poison Control Center.³ A recent article

cited frequent inquiries to a National Poisons Information Service but reported few serious complications from ingestion.⁴ To the authors' knowledge, this subject has yet to be addressed in the otolaryngology literature. We present our 5-year experience with children who presented to the Primary Children's Hospital Emergency Department following detergent ingestion and include a proposed management algorithm (Salt Lake City, Utah).

MATERIALS AND METHODS

Following institutional review board approval by the University of Utah and Primary Children's Hospital, patients who ingested detergent pods were identified using our university medical billing database for the International Classification of Diseases, Ninth Revision, code for poisoning by detergent (976.2). The patients were treated between June 2010 and March 2015. Patient demographic information obtained included age at the time of ingestion, gender, type of detergent ingested, symptoms at time of presentation, intervention, and clinical course. The primary endpoints were to describe the clinical effects of detergent pod exposure and to describe the proportion of exposed patients who were discharged, observed, or admitted to the hospital. Data were summarized using Excel (Microsoft; Redmond, WA), including proportions for nominal data and mean for continuous data.

RESULTS

We identified nine cases of detergent ingestion (Table I). The average age was 26.3 months (range, 11–43 months). Eight (89%) of the cases were female. The patients had ingested laundry detergent pods (n = 7)

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TABLE I.
Clinical Characteristics of Each Child Following Detergent Ingestion.

Patient no.	Age (mo)	Type of Pod	Symptoms	Clinical Course
1	43	Laundry	Throat pain	Observation unit
2	23	Dishwasher	Drooling, emesis	Observation unit; EGD normal
3	18	Laundry	Drooling, emesis, respiratory distress	Admitted to hospital and discharged next day
4	40	Laundry	Emesis	Discharged from ED
5	40	Laundry	Throat pain, emesis, cyanotic episode	Observation unit
6	25	Dishwasher	Foaming from mouth	Discharged from ED
7	11	Laundry	Foaming from mouth, emesis, tachypnea	Observation unit
8	19	Laundry	Foaming from mouth, emesis, respiratory distress	Intubated; vocal fold paresis; EGD normal, extubated 5 days later
9	18	Laundry	Drooling, emesis, stridor, hoarseness	Observation unit

ED = emergency department; EGD = esophagogastroduodenoscopy; HD = hospital day.

and dishwasher detergent pods ($n = 2$). The majority of patients (67%) had more than one clinical manifestation from ingestion, including emesis (78%), respiratory symptoms (56%), throat pain (22%), drooling (33%), and foaming at the mouth (33%). Respiratory symptoms included stridor, coughing, cyanosis, or respiratory depression.

The management of patients depended on the severity of their symptoms. Five (56%) children were admitted overnight to an observation unit. Once able to demonstrate adequate oral intake, they were discharged the following day. Two patients (22%) were determined appropriate for discharge to home directly from the emergency department due to mild symptoms that resolved during a period of observation for at least 3 hours. Two (22%) children underwent esophagogastroduodenoscopy (EGD) based on surgeon preference to further evaluate mild gastrointestinal symptoms. Neither of the children demonstrated evidence of esophageal or gastric mucosal injury, and there were no cases of perforation.

One 19-month-old child (case 8) presented to an outside emergency department immediately after a witnessed ingestion of a Tide (Proctor & Gamble, Augusta, GA, Cincinnati, Ohio.) detergent pod. The patient had an episode of emesis before arrival. One hour later, the patient developed coughing, stridor, increased work of breathing, and inability to handle secretions. The patient received a treatment of IV dexamethasone and nebulized racemic epinephrine and was transferred to our tertiary children's facility. Due to the severity of the patient's symptoms, general surgery performed a panendoscopy. Esophagogastroduodenoscopy demonstrated normal mucosa, and bronchoscopy revealed significant upper airway erythema and thick secretions throughout the tracheobronchial tree. The patient remained intubated and was transferred to the pediatric intensive care unit (PICU). The otolaryngology service was consulted to evaluate the patient's airway the following day, and the patient was taken to the operating room for an extubation trial. The patient's chest X-ray demonstrated perihilar opacities but no overt signs of aspiration or pneumonia. Immediately following extubation, the

patient was tachypneic, stridulous, and demonstrated severe intercostal retractions. A flexible laryngoscopy demonstrated moderate glottic edema (Fig. 1) and limited abduction of bilateral true vocal folds. Rigid bronchoscopy showed mild tracheal edema and moderate secretions throughout the trachea and mainstem bronchi (Fig. 2). The patient was therefore reintubated, started on steroids, and transferred back to the PICU. Four days later, the patient underwent successful extubation, at which time vocal fold mobility was normal. The patient was transferred to the floor and discharged 4 days later, after demonstrating adequate oral intake.

DISCUSSION

Our series corroborate larger studies in demonstrating that laundry pod injuries most often present with mild symptoms but may rarely cause serious injuries. Emesis was the most common presenting symptom, seen in 60% of 1,215 children in a study from the United



Fig. 1. Edema and lack of bilateral vocal-fold abduction prohibited successful extubation.



Fig. 2. Tracheal edema and secretions 1 day after detergent ingestion in an intubated child.

Kingdom⁴ and in 56% of 13,730 children in the largest study to date in the United States.³ The most common clinical findings in detergent ingestion among these large cohorts were mild aerodigestive symptoms such as emesis, drooling, foaming at the mouth, and coughing without permanent sequelae.³⁻⁵ The two children in our series who underwent EGD did not show evidence of mucosal injury. Cases of esophageal injury following pod ingestion have rarely been described, including a report of three patients who developed mild to moderate esophageal damage in the absence of oral erythema, ulcers, or swelling.⁶ A review of five symptomatic pediatric patients who underwent endoscopy reported three cases of esophageal erythema, one with pseudomembranous lesions and another with esophageal ulcers.⁷ Larger series of detergent pod ingestion do not report esophageal damage, and there are no reports of esophageal strictures to date.

Although most injuries are mild in nature, the otolaryngologist should be aware of infrequent but serious complications of detergent pods and how these may differ from traditional detergent formulations. Liquid detergent pods come as a single-use concentrated formula within a water-soluble membrane that erupts when coming into contact with saliva.⁵ Pod-exposed children had significantly more adverse health effects such as coma, need for intubation, or mechanical ventilation when compared to ingestion of traditional liquid detergents.^{5,8} Liquid and pod detergents contain similar solvents, but it is not known why the clinical effects seem to be more severe for pods.⁹ The pH of different brand name pods is relatively neutral based on Material Safety Data Sheet data (Tide pods [Proctor & Gamble] and Gain Fling capsules [Proctor & Gamble] have a pH of 6.8 to 7.4; All capsules [Sun Products Corp., Wilton, CT] have a pH of 7.6). The mechanism of injury remains unknown at this time and may be related to the

concentrated formula of the detergent. Cases of altered mental status have been postulated to stem from the ethanol contained in anionic and nonionic surfactants, as well as propylene glycol, both of which contribute to central nervous system depression.¹⁰

Among children younger than 6 years old who were reported to have ingested laundry detergent pods to United States poison control centers, 4.4% were hospitalized and 7.5% experienced a moderate or major medical outcome, including one confirmed death.³ The fatality was confirmed by autopsy in a 7-month-old boy in Florida after ingesting a detergent pod. Rarely, tracheal intubation and mechanical ventilation are required after ingestion and aspiration of detergent pods.^{4,8,9,11} Valdez et al. reported that 102 (0.6%) of 17,230 children required intubation following detergent pod ingestion.³ Fraser et al. reported that four out of five children with airway injury from detergent pod ingestion required intubation. Of those, one developed webbing of the anterior commissure and subglottic stenosis requiring a cricotracheal split.¹² To the authors' knowledge, the finding of bilateral true vocal fold immobility has not been previously described in association with detergent ingestion. We postulate that this child's inability to fully abduct bilateral vocal folds may be secondary to corrosive injury to the recurrent laryngeal nerves or from severe edema due to direct caustic effects of the detergent.

The limitations of this study are those inherent to a retrospective chart review. We may not have captured all patients with detergent ingestion secondary to coding at the time of evaluation in the emergency department. An accurate physical exam and documentation of symptoms is also dependent on the provider at the time of evaluation. The children did not have a follow-up exam or endoscopy to determine long-term complications from detergent exposure. Although the small size of the cohort prevents the authors from making generalizations, our series is consistent with clinical findings from larger studies in that most children did not undergo endoscopic intervention. At this time, there is no consensus regarding indications for endoscopy following detergent pod ingestion. In this series, indication for EGD appeared to be dictated by the personal preference of the surgeon. It is plausible that patient 2 (Table I) did not warrant the risks of general anesthesia for esophagoscopy. None of the children in our series demonstrated transmural injury. The majority of children were observed for a short time in the emergency room or overnight and were discharged after a trial of oral intake.

We propose a management algorithm based on the authors' experience and those of larger studies (Fig. 3). Many children may be observed in the absence of severe gastrointestinal or airway symptoms. However, given the potential for complications, we maintain a low threshold for surgical evaluation in the child with airway symptoms. Respiratory distress most commonly presents early in the clinical course, which should prompt more aggressive management with bronchoscopy. We suggest that if a child will require general anesthesia, evaluation of the complete aerodigestive tract with panendoscopy may be warranted but should be

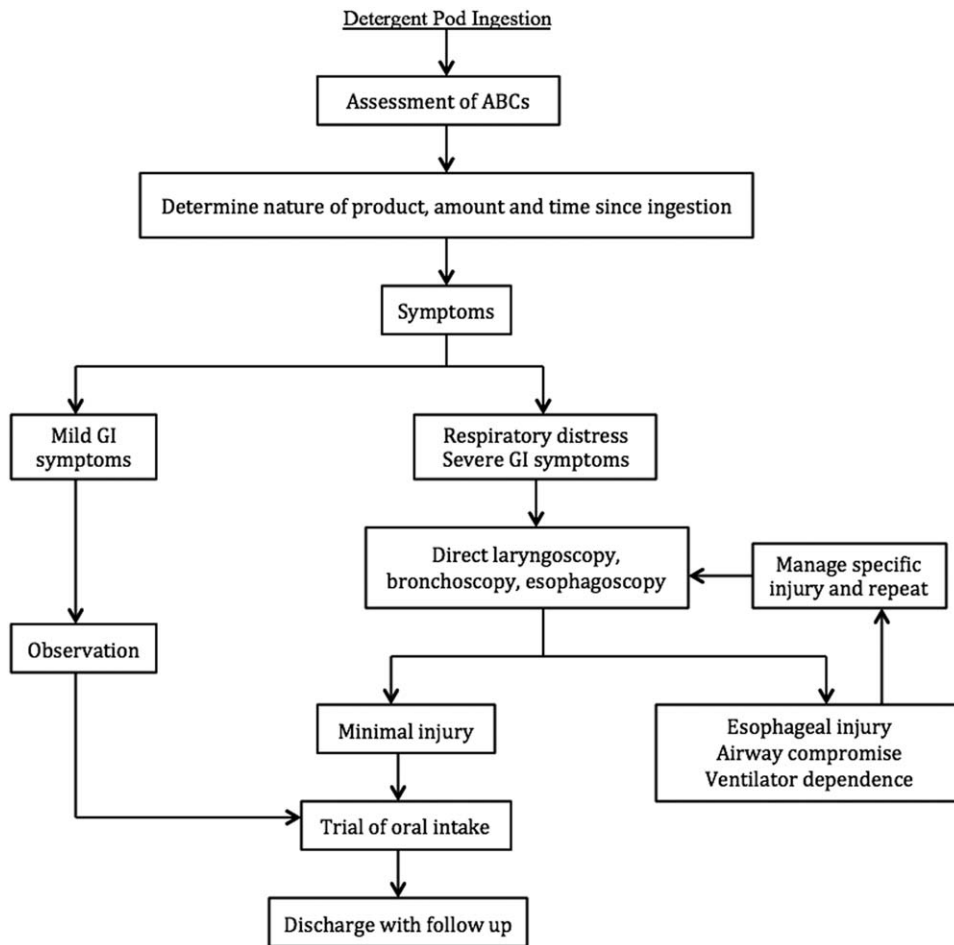


Fig. 3. Proposed algorithm for management of detergent pod ingestion in children. ABC = airway, breathing, and circulation; GI = gastrointestinal.

determined on a case-by-case basis, taking into account the amount of exposure and time interval since ingestion. Should the child complain of dysphagia, dysphonia, or stridor at the time of follow-up at 4 to 6 weeks, then a repeat endoscopy should be considered to rule out laryngotracheal stenosis or esophageal stricture.

This study also highlights the need for awareness, not only among otolaryngologists but also among parents and manufacturers, regarding the risks of detergent ingestion. Progress toward increasing patient safety has been initiated, such as child-resistant packaging, product safety warning, and public education. Various manufacturers have investigated the addition of a bittering agent and a less concentrated constituent reformulation.

CONCLUSION

Despite the frequency of detergent pod ingestion since introduction of the product to the U.S. market, this topic has not been addressed in the otolaryngology literature. There is an ongoing need for prevention and education regarding detergent ingestion. Our experience demonstrates a wide range of effects to the upper aerodigestive tract, from mild gastrointestinal symptoms to vocal fold immobility. The majority of children improve with observation alone; however, clinicians should maintain a low threshold for endoscopic evaluation in

cases of severe gastrointestinal symptoms and airway involvement.

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