

FOLIA MEDICA CRACOVIENSIA

Vol. LVI, 4, 2016: 21–29

PL ISSN 0015-5616

Lower esophageal sphincter relaxation by administrating hyoscine-N-butylbromide for esophageal impaction by coin — shaped foreign bodies; prospective clinical study in pediatric population

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Abstract: Aim of the present study is the presentation of our experience in conservative treatment of coin-shaped, ingested foreign bodies in lower esophagus and the consideration about the indications of this method's appliance in clinical practice.

From 2011 to 2014, 79 children in total (45 male — 34 female), aged from 8 months to 13 years (average 4.8 years) were admitted to our Department due to foreign body ingestion. In 21/79 patients the foreign body lodged in the esophagus, in 9 in the upper and in 12 in the lower esophagus. Cases of pre-existing esophageal stricture or of esophageal obstruction, due to sharp or linear foreign bodies or disk battery, were excluded. Finally, our study group consisted of 11 patients, aged from 10 months to 10 years (average 4.6 years). The average time elapsed from the ingestion of the foreign body until the admission of the child in the Emergency Department was 4 hours. Young patients were administered suppository form of hyoscine-N-butylbromide, followed by repetition of radiograph 6 hours later. In 9 cases the ingested foreign body passed to the stomach within the first six hours, while in 2 cases no alteration of its position was noted, thus endoscopic removal followed. In these 9 cases the foreign body passed through the gastrointestinal (GI) tract and was excreted within the next 1–3 days. Smooth muscle relaxation of the lower esophageal sphincter after administration of hyoscine-N-butylbromide was successful in 82% of our patients, while the success rate in relevant publications ranges from 20 to 42%.

In conclusion, it is worth noting that the pharmaceutical relaxation of the lower esophageal sphincter is a safe alternative method of treatment in cases of foreign bodies lodged in the lower esophagus, except for linear or sharp objects or coin batteries. Given that the majority of hospitals in Northern Greece lacks of

pediatric gastroenterologists, while endoscopic intervention — when indicated — should be conducted early after admission, it is obvious that the proposed method becomes essential.

Key words: Foreign body ingestion, impaction, esophagus, lower esophageal sphincter relaxation.

Introduction

According to the study of Kramer *et al.* [1] the incidence of foreign body ingestion in the pediatric population in the U.S. is 116.000 cases per year. 75–85% of these incidents concerns children younger than 5 years (average 18–48 months). Webb [2], Cheng *et al.* [3], Panieri *et al.* [4] come to similar conclusions.

Esophagus is the most common site of impaction of ingested foreign bodies. This can occur either in one of the esophageal constrictions (most frequent at the cricopharyngeal muscle, followed by the lower esophageal sphincter and finally where esophagus is crossed by the aortic arch) or in secondary esophageal strictures [5]. The latter can occur due to gastroesophageal reflux disease, eosinophilic esophagitis, after surgical treatment of esophageal atresia, achalasia, extrinsic pressure and finally neuromuscular disorder affecting esophageal motility [5]. Parameters that determine the probability of impaction of a coin-shaped foreign body are the subject disorders or anatomic anomalies, patient's age and the diameter of the ingested object. In children 5 years old or less, after ingestion of a foreign body greater than 2.4 cm in diameter, the probability of its impaction in the esophagus increases dramatically [6, 7].

Impaction of a foreign body potentially can cause mucosal erosion, ischemia, perforation, mediastinitis, pneumomediastinum, extrinsic pressure on the airway [8, 9]. Impaction of a foreign body in the esophagus can lead to serious and life-threatening complications, therefore it is considered as urgency in Pediatric Surgery.

Aim of this study is to present our experience, gained between 2011 and 2014, in appliance of lower esophageal sphincter's relaxation by using hyoscine-N-butylbromide for the treatment of impacted, coin-shaped foreign bodies in the lower esophagus. Subsequently, we aim at presenting the indications of this method and the restrictions, as well.

Material and methods

From 2011 to 2014, 79 children (45 male and 34 female) — aged from 8 months to 13 years (average 4.8 years) were admitted to the 1st Department of Pediatric Surgery, Aristotle University of Thessaloniki, due to foreign body ingestion. In 21/79 cases (26.6%) the foreign body was impacted into the esophagus. In 9 cases (42.8%) in the upper and in 12 cases (57.2%) in the lower esophagus. 6 cases were excluded from

this retrospective study, due to: pre-existing esophageal strictures (2/6), impacted linear (2/6), or sharp (1/6) foreign body or disk (1/6) battery. Hence, our study group consisted of 11 patients, aged from 10 months to 10 years (average 4.6 years).

The average time elapsed from the ingestion of the foreign body until the admission of the child in the Emergency Department was 4 hours. In 8/11 cases the impacted foreign body was a coin, in 2/11 cases a plastic component of a toy and in 1/11 a coin-shaped, metallic component of a toy. Their size ranged from 0.7 to 2 cm.

Key point in the diagnostic approach of these patients was the concern of their escorts about the possibility of foreign body ingestion: in 9 cases the parents, in 1 case the grandmother and in 1 case the older brother. In the context of a thorough diagnostic procedure, while taking the medical history, we emphasized on the possibility of ingestion of a disk battery.

5/11 patients complained about symptoms suggestive of foreign body impaction: difficulty in swallowing liquids (2/11), difficulty in swallowing solid food (2/11), salivation (1/11) and burning retrosternal pain (1/11). Physical examination followed, with emphasis on the presence of stridor, wheezing or respiratory distress.

The next step was the conduction of a plain posteroanterior radiograph of neck, chest and upper abdomen in upright position. In 9/11 patients a radiopaque foreign body located on the lower esophagus was depicted. In 2 patients, the administration of isotonic contrast agent was required, in order to make the diagnosis. In 1 patient we confronted with a differential diagnostic problem, whether it was impaction of a disk battery or a coin. Thus, we requested for a chest and upper abdomen lateral radiograph, in order to distinguish a coin (the two surfaces had the same diameter) from a disk battery (double halo sign). It should be noted that the surface respectively to the negative pole of the battery had the smaller diameter, which is indicated in the lateral radiograph, through the depiction of a notch in its perimeter.

Admission of the patients and conduction of the routine preoperative control followed. Young patients were administered suppository form of hyoscine-N-butylbromide in a single dose, 20 mg. Repetition of radiograph was requested 6 hours after the admission.

Results

In 9/11 cases the impacted foreign body finally passed to the stomach within the first 6 hours after hyoscine-N-butylbromide administration. In 2/11 cases no alteration in its position was noted, thus endoscopic removal of the foreign body was conducted within the first 24 hours after ingestion. In those cases, in which the passage of the foreign body to the stomach was achieved, it was eventually excreted rectally without complication within the next 1–3 days. Radiographic confirmation of the successful relaxation of the lower esophageal sphincter and subsequently uncomplicated passage

of the foreign body through the GI tract, allowed the patients' feeding. Patients were dismissed home in excellent general condition the next day.

In those 2 cases, in which endoscopic intervention under general endotracheal anesthesia was requested, no lesions or pathological signs — indicative of pre-existing esophageal disease or secondary, due to the pressure that the impacted foreign body exerted — were identified. Feeding began 24 hours later, while the patients were dismissed home 48 hours after the endoscopic intervention.

Discussion

Concerning the proper time of intervention in patients with esophageal obstruction after foreign body ingestion, it could be divided into: emergent, within the first 2 hours after ingestion, urgent, within the first 24 hours and elective, 24 hours after the ingestion or later (Table 1) [10]. Patients with upper esophageal obstruction and patients with indication of direct endoscopic intervention were excluded from our material.

Table 1. Grouping of impacted foreign bodies in the esophagus based on the proper time of intervention.

Type of foreign body	Esophageal impaction	Symptoms	Appropriate time of intervention
Disk battery	Yes	Regardless	Directly
Magnet	Yes	Due to lumen's obstruction	Directly if patient is symptomatic. Differently within the first 24 hours
Sharp object	Yes	Due to lumen's obstruction or perforation of esophageal wall	Directly if patient is symptomatic. Differently within the first 24 hours
Food bolus	Yes	Due to lumen's obstruction	Directly if patient is symptomatic. Differently within the first 24 hours
Coin or coin-shaped object (except batteries)	Yes	Due to lumen's obstruction	Directly if patient is symptomatic. Differently within the first 24 hours
Linear object	Yes	Regardless	Directly
Foreign body with absorptive capacity	Yes	Due to lumen's obstruction	Directly if patient is symptomatic. Differently within the first 24 hours

If the impacted foreign body is not radiopaque, lateral radiograph may help in diagnostic procedure, in order the foreign body not to be overlaid in the bodies of the thoracic vertebrae. Alternatively, oral administration of isotonic contrast may also help. In cases of esophageal obstruction induced by a non-radiopaque foreign body, conduction of computed tomography, after oral administration and intravenous

injection of contrast, is absolutely indicated, as both the position and the type of the impacted object are identified in 83–100% of all cases [11, 12].

Key point during the diagnostic approach was the exclusion of the probability of a disk battery impaction, which would be indicative of direct endoscopic intervention. Double halo sign, which is a pathognomonic imaging feature of a disk battery, was not identified in any of our patients [13]. Disk batteries can be either cylindrical or coin-shaped, while the classification is based upon the size, the chemical composition and their voltage. Chemical composition between the two poles may be different. Nowadays it is known that 99.3% of the disk batteries greater than 20 cm in diameter are lithium batteries [9]. Parameters that determine the possibility of complications, even life-threatening, after battery ingestion are: the position of impaction, the chemical composition, the diameter, the stored energy, the voltage, child's age and of course time of diagnosis [14]. If the ingested battery is new, it is 3.2 times more corrosive than an already used battery [3]. This has been attributed to the absence of typical symptoms, but also the absence of well-developed spoken language in these patients.

As for the therapeutic options in impacted foreign bodies in the esophagus, they include: the endoscopic removal, removal using a Foley catheter, bougienage (promotion of the ingested object into the stomach), removal using the Magill forceps (when the foreign body is located on the upper third of esophagus), pharmaceutical smooth muscle relaxation of the lower esophageal sphincter and finally “watch and wait” strategy, until the ingested foreign body passes to the stomach. It is obvious that the last two are the most conservative options, as no invasive procedure or general anesthesia is required. Administration of proteolytic enzymes, such as papain, as a therapeutic option in food bolus impaction in the lower esophagus has been abandoned, because it has been implicated both in causing esophageal erosions and perforation and development of hypernatremia, as well [15, 16].

“Watch and wait” strategy has been based on the studies conducted by Tander *et al.* [6] and Waltzman *et al.* [17], which have shown that 27–30% of impacted coins in the upper esophagus and 56–60% of the same objects impacted in the lower esophagus finally pass to the stomach. According to Connors *et al.* [18] and Soprano *et al.* [19], “watch and wait” strategy is acceptable solution, when the patient is asymptomatic, because 80% of the impacted foreign bodies located in the lower esophagus will automatically pass to the stomach within the next 24–48 hours. According to ASGE Standards of Practice Committee guidelines [20] this strategy can be attempted in symptomatic patients as well, but not beyond the first 12–24 hours. In our opinion, this strategy should not be attempted beyond the first 12–18 hours on the one hand because of the potential risk of complications due to foreign body impaction in the esophagus and the local pressure that it exerts and on the other hand, in order to avoid secondary constrictions, especially in symptomatic patients, such as 5/11 patients of our study group.

Pharmaceutical smooth muscle relaxation of the lower esophageal sphincter can be attempted by administration of glucagon, benzodiazepines, calcium channel blockers, papaveretum, nitrates and hyoscine-N-butylbromide. We were skeptical about the use of benzodiazepines or papaveretum, due to their repressive action and the potentially increased risk of aspiration. We did not also administer nitrates or calcium channel blockers due to the probability induction of hypotension.

Intravenous administration of glucagon in a single dose 0.02–0.03 mg/kg (max. 0.5 mg in total) is the most often applied conservative method, in order to induce relaxation of the lower esophageal sphincter. It is a polypeptide normally secreted by the A cells of islets of Langerhans in the pancreas. Few minutes after glucagon administration, resting pressure of the lower esophageal sphincter is reduced [21, 22]. Its administration is contraindicated when pheochromocytoma or insulinoma co-exists or when the patient suffered from hypersensitivity reaction in a former administration of the same drug [21, 23]. However, in studies conducted by Al Haddad *et al.* [24] and Metha *et al.* [25] it was estimated that the above method has low success rates (12–50% of all cases), compared to those of placebo. Bodkin *et al.* [26] applied the pharmaceutical relaxation of the lower esophageal sphincter by administering glucagon in 127 patients (both children and adults) with impacted foreign body in the lower esophagus (group A), comparing the results with a second group consisting of 29 patients, in whom glucagon was not administered (group B). Successful outcome was noted only in 14% of patients of group A versus 10% of the group B. They also noted that almost 13% of group A patients had severe nausea and vomiting after glucagon administration. Thus, they consider glucagon administration as ineffective and inappropriate.

Hyoscine-N-butylbromide, an antimuscarinic agent, contributes to the smooth muscle relaxation of the lower esophageal sphincter, due to its anticholinergic effects. It is absolutely contraindicated in patients suffering from glaucoma or subcystic obstruction. Basavaraj *et al.* [27] and Anderson & Lee [28] are cautious about the effectiveness of this therapeutic option. Basavaraj *et al.* [27] encountered in a 6-year period 43 patients with food bolus impaction in the esophagus. In 35 patients they administered hyoscine-N-butylbromide (group A), while in the rest 8 patients they followed the “watch and wait” strategy. Successful outcome was noticed in 68% of patients in group A and in 62% of those consisting group B ($p = 0.37$). Tomas *et al.* [29] confronted with 31 cases of food bolus impaction in 29 patients in total. In 22/31 cases they administered hyoscine-N-butylbromide (group A), while in the rest 9 cases they followed the “watch and wait” strategy (group B). The outcome was successful in 82% of cases in group A and in 78% of those in group B ($p = 0.577$). After systematic and thorough research of the current literature, it can be easily concluded that there are only a few relevant publications, with emphasis on the treatment of food bolus impaction. Besides, according to Anderson and Lee [28], each group of

a clinical study should identically consist of at least 140 cases, in order to lead to a statistically significant result.

Nevertheless, smooth muscle relaxation of the lower esophageal sphincter achieved with hyoscine-N-butylbromide was successful in 82% of our patients, in contrast to relevant publications, in which the success rate ranges from 20 to 42%. This notice was also the motive for present clinical study.

Vicente *et al.* [5] observed that, in 8 pediatric patients with food bolus impaction that was removed endoscopically, the pathophysiologic substrate was the gastroesophageal reflux disease. In our 2 patients, in whom endoscopic intervention was required, there was no evidence of esophagitis or other pre-existing disease, such as eosinophilic esophagitis, so we considered that there was no indication of further diagnostic investigation.

Conclusion

In our opinion, in cases of foreign body impaction in the lower esophagus, in which there is no indication for urgent endoscopic intervention and removal (coin-shaped battery, linear or sharp object), pharmaceutically induced smooth muscle relaxation of the lower esophageal sphincter by administrating hyoscine-N-butylbromide is a safe alternative therapeutic option. Based on this, the endoscopic removal, which would give the final solution if necessary, is not circumvented. The necessity of such safe and relatively effective alternative options becomes more important, when a hospital lacks of a pediatric gastroenterologist.

Acknowledgments, funding and disclosures

This study has not been funded. Patoulias Dimitrios and Patoulias Ioannis organized the prospective clinical study, while all the authors took part in the management and the treatment of the involved patients.

Conflict of interest

None declared.

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