

# Esophageal pH Capsule Retention

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## ABSTRACT

The wireless pH capsule is widely used to evaluate gastroesophageal reflux disease in patients. Common complications include premature capsule detachment, dysphagia, chest pain, and technical malfunctions. We present a 6-year-old boy who presented to our institution with a 2-day history of coffee-ground emesis. A pH capsule was found to be lodged in his distal esophagus 45 days after initial placement. We explore the possible reasons for capsule retention and briefly discuss the safety implications of this finding because we believe that this complication may be underreported.

## INTRODUCTION

Wireless, catheter-free intraesophageal pH monitoring devices are regularly used to evaluate gastroesophageal reflux disease (GERD). They have been shown to be better tolerated than conventional catheter-based methods.<sup>1</sup> In adults, the probe is endoscopically placed 6 cm above the squamocolumnar junction. In children, the optimal location for placement is determined by calculating the distance from the nostril to the gastroesophageal junction per the Strobel formula.<sup>2</sup> After a vacuum pump applies suction to fasten the probe to the esophageal wall, the pH data can be recorded for 48 hours or longer with subsequent capsule detachment within 5–7 days.

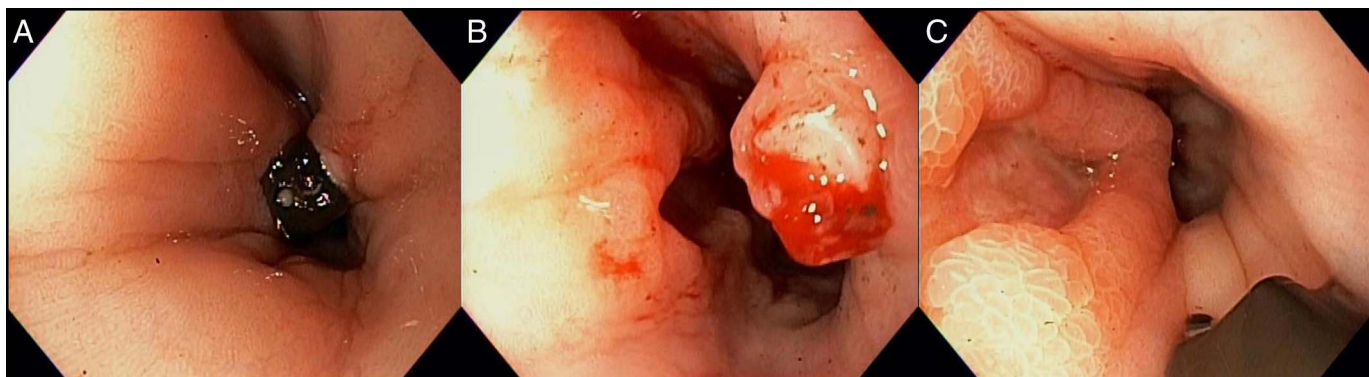
The literature reports premature detachment, dysphagia, chest pain, and technical malfunctions of pH electrode or receiver as common complications and aspiration, esophageal perforation, and dislodgement into the pyriform sinus and nasopharynx as severe complications.<sup>3–12</sup> Despite multiple studies evaluating the tolerance, safety, and efficacy of the wireless device, limited reports of capsule retention after completion of the pH study exist.<sup>5–7,13–15</sup>

## CASE REPORT

A 6-year-old boy with a medical history significant for spastic quadriplegic cerebral palsy, global developmental delay, seizure disorder, gastrostomy tube dependence, and severe erosive GERD presented with multiple episodes of coffee-ground emesis for 2 days. Laboratory abnormalities included a hemoglobin count of 6.3 g/dL. Abdominal radiographs revealed a retained pH monitor placed 45 days before presentation. He underwent an upper endoscopy for evaluation of coffee-ground emesis and device removal. An irregularly pale esophagus with no active bleeding was visualized with fibrosis alternating with reactive hyperplastic tissue growth noted in the mid to distal esophagus. Significant hyperplastic tissue growth was noted along the region where the capsule was lodged (Figure 1). The device was removed via a cold snare without complications, and the patient was discharged 3 days later.

## DISCUSSION

Although our patient's symptomatic presentation prompted the investigation and subsequent detection of the retained capsule, 2 previously reported cases were discovered incidentally within 15 days of placement by radiographic imaging performed after study completion.<sup>16,17</sup>



**Figure 1.** Upper endoscopy showing (A) wireless pH capsule retained in the esophagus, (B) hyperplastic tissue growth at the site of capsule insertion, and (C) a closer view of hyperplastic tissue growth on the opposite wall of the retained pH capsule after device dislodgement.

Given our patient's complex medical history, it is difficult to ascertain whether the retained capsule was responsible for his presenting symptoms. He had no history of coffee-ground emesis or anemia, but his previous esophagogastroduodenoscopy was significant for erosive esophagitis. It can be speculated that the endoscopic evidence of fibrosis indicated mucosal irritation from the device, which may have worsened his GERD by increasing hypersalivation, regurgitation, and retching.

We speculate that the cause of capsule retention may be multifactorial. It is worth noting that our patient was neurologically impaired and nonverbal. It is possible that both his neurologic impairment and inability to communicate any discomfort or dysphagia contributed to the long retention period. In neurologically impaired children, foregut motility disorders including the absence of lower esophageal sphincter tone, delayed gastric emptying, and decreased antroduodenal motor function have all been reported.<sup>18–20</sup> Altered gastrointestinal (GI) motility may put these children at an above average risk for Bravo capsule retention.

The US Food and Drug Administration-regulated Manufacturer and User Facility Device Experience Database includes device-related adverse event reports from the past 10 years.<sup>21</sup> Since 2009, 30 reports documenting capsule retention have been published on the database. Four reports document a retention time between 5 and 7 days, which is within the expected time interval before spontaneous dislodgement. However, 3 of these patients reported chest pain, prompting endoscopic removal. There are 26 reports that document probe retention time ranging from 9 days to 6 weeks. Of those, 10 noted that the capsules were detected because the patients presented with symptoms such as chest pain and odynophagia. Fifteen reports did not include details about patient presentation, and one patient was asymptomatic on probe discovery. In a study, the patient with the retained capsule was to undergo a Heller myotomy, suggesting underlying esophageal dysmotility or achalasia.<sup>17</sup> The singular Manufacturer and User Facility Device Experience report documenting an asymptomatic patient with a retained device noted that the patient had severe reflux scarring.<sup>21</sup> Given that the capsule is generally placed in individuals

with concerns for GERD, patient comorbidities, altered GI motility, and underlying mucosal scarring or inflammation may contribute to possible device retention.

Another unique aspect of this case is the endoscopic finding of hyperplastic tissue growth around the probe, which likely contributed to capsule retention. This may be consistent with a foreign body-like reaction of the esophageal mucosa to the capsule. No similar findings were discussed in the previous reports of retained capsules, although a case report described the development of granulation tissue at the capsule site within 24 hours of probe placement.<sup>22</sup> In our case study, the tissue grew around the capsule, acting as a nest and partially entombing the retained probe. The patient's underlying GERD and erosive esophagitis may have also stimulated excess tissue development, preventing the spontaneous dislodgement of the probe.

We would be remiss to exclude the possibility of a technical error leading to capsule retention. To place the probe, our institution applies a vacuum pressure of 550 mm Hg for 30 seconds per manufacturer recommendations.<sup>1</sup> Although unlikely, it is possible that the pressure was too high, resulting in deeper penetration of the probe into esophageal mucosa. Provider experience is unlikely to play a significant role in the case described above because this was the first reported occurrence of retention for the provider in over 12 years.

Cases of retained capsules may be underreported because of asymptomatic retention. In addition, no recommendations currently exist regarding patient selection or to assess the status of the pH probe after placement. Multiple studies have demonstrated that the capsule is safe and well-tolerated in children and adults with acid reflux symptoms, making it a favorable alternative to conventional techniques. However, there may be higher rates of capsule retention than previously believed, especially in children with neuromuscular disorders where altered GI motility and inability to communicate symptoms may increase their risk for Bravo capsule retention. Although additional studies are needed to determine whether radiographic imaging should be routinely performed, patients with neuromuscular disorders may

benefit from radiographic imaging 1–2 weeks later to ensure spontaneous capsule detachment. In addition, it is important for providers to take into consideration patient selection and weigh alternative options carefully because this patient may have had a better outcome if conventional esophageal catheter pH monitoring had been used instead.

## DISCLOSURES

Author contributions: All authors contributed equally to this manuscript. T. Truong is the article guarantor.

Financial disclosure: None to report.

Informed consent was obtained for this case report.

Received November 30, 2019; Accepted March 4, 2020

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