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A rare case of neurogenic belching caused by surgical tacks

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Abstract
Gastric belching is a normal physiologic process whereby air travels in a retrograde fashion from the stomach out the mouth, whereas supragastric belching is considered to be behavioral and occurs when swallowed air originating in the esophagus exits the mouth. After hiatal hernia repair, patients commonly report an inability to belch. However, a drastic increase in belching after hiatal hernia repair is highly unusual. We present a rare case of surgically induced, pseudo-supragastric belching caused by phrenic nerve irritation from surgical tacks placed during hiatal hernia repair. The patient's symptoms resolved completely after the tacks were removed during the repeat operation. Surgeons should pay careful attention to the diaphragmatic and phrenic nerve anatomy and must take extreme care during mesh fixation to the hiatus during foregut surgery.

Keywords: Supragastric, gastric, neurogenic, belching, hiatal, paraesophageal, hernia

Introduction
Belching, also known as eructation or more informally as "burping", is a process in which air travels from the esophagus, into the pharynx, and out the mouth. There are two main types of eructation, namely gastric and supragastric. Gastric belching, the most common form of eructation, is considered a normal physiologic process that occurs when gastric distention causes vagally-mediated lower esophageal sphincter (LES) relaxation, leading to air exiting the stomach in a retrograde fashion. Comparatively, supragastric belching occurs when air originating from the esophagus itself exits during esophageal contraction. Supragastric belching is typically considered voluntary and behavioral and thus the management includes cognitive behavioral therapy [1]. Esophageal impedance testing is frequently used to help differentiate between gastric and supragastric belching [2].
Hiatal hernias (HH) are defined by an abnormal entry of abdominal contents into the thoracic cavity via the esophageal hiatus of the diaphragm. Definitive management of hiatal hernias includes the surgical reduction of the herniated contents and typically the creation of a fundoplication whereby the gastric fundus is wrapped around the distal esophagus to re-create a new LES [3]. HHs typically present with reflux, bloating, and dysphagia, but can also be associated with mild belching. However, after surgical repair of a HH, one of the most commonly associated symptoms is the subjective feeling of being unable to belch and the subsequent increase in bloating and rectal flatulence [4]. The etiology of the inability to belch after fundoplication is thought to be related to the reduced relaxation of the newly formed LES [4]. Thus, fundoplications are thought to decrease gastric belching specifically, and likely have little effect on supragastric belching [5].
While postoperative belching is a well-known phenomenon after bariatric surgery [6], to our knowledge, there are no known case reports of surgically induced severe belching after HH repair. Here, we report a case of incessant belching due to phrenic nerve irritation from surgical tacks placed during HH repair. While impedance testing seemed to suggest the presence of supragastric belching, physiologically, this patient's belching represents a rare type of neurogenic, pseudo-supragastric belching.

Case Report
The patient was a 65-year-old male who presented to our surgical clinic with a chief complaint of severe, incessant belching. A few years earlier, the patient had been diagnosed with a large, type 3 paraesophageal HH found on upper endoscopy. He had multiple symptoms including dysphagia, heartburn, and mild belching. He had failed medical management of these symptoms.

The HH was confirmed on contrast esophagram and on computed tomography, which revealed the entirety of the stomach in the thorax. High resolution esophageal manometry at that time revealed normal esophageal motility and a low LES resting pressure of 12 mmHg (residual pressure -1.3 mmHg). Eight months before his presentation to our surgical clinic, the patient underwent a laparoscopic HH repair at another facility with placement of a biologic mesh and a posterior, partial 270° fundoplication. Per the operative note, the surgeon fixated the mesh to the hiatus with a non-absorbable tacking device and surgical glue.

Immediately after surgery in the recovery room, the patient noted that his previously mild belching had become constant and severe in nature. This persisted over the following weeks. At times, the belching would occur up to 20 times a minute, such that he would be unable to speak. The belching was very distressing to the patient and his family, and it was significantly impacting his quality of life. Additionally, his other symptoms of dysphagia and heartburn were partially but incompletely relieved after surgery.

Initial medical treatments for the belching — including elimination of carbonation, avoidance of straws, taking small bites of food, eating slowly, and sleeping with his head of bed elevated — were unsuccessful. Oral diazepam, promethazine, and baclofen were all associated with mild, temporary symptom relief, but caused drowsiness and ultimately failed to stop the persistent belching. A repeat barium esophagram revealed normal post-surgical changes with no recurrence of the HH. A gastric emptying study to evaluate for gastroparesis was normal.

The patient was desperate for relief from his embarrassing and life-altering belching and was referred to our surgical clinic by the prior surgeon. Further workup included high-resolution esophageal manometry which revealed normal LES metrics and adequate motility, but also showed frequent, rapid esophageal body sequences. Esophageal impedance and pH monitoring testing demonstrated increased acid exposure in the distal esophagus (DeMeester score of 22.2; normal < 14.72) and the presence of what appeared to be supragastric belching. Consideration was given to the possibility of phrenic nerve injury or entrapment from securing the biologic mesh from his previous surgery as a cause of his symptoms. As such, a decision was made to take the patient to the operating room for a diagnostic laparoscopy and possible mesh excision and revision of the prior HH repair and fundoplication.

In the operating room, upper endoscopy was first performed which suggested a small recurrence of his previous HH. A robotic-assisted laparoscopic approach was used to dissect around the hiatus, first by performing significant adhesiolysis. During dissection, it was noted that residual biologic mesh was still present, although somewhat attenuated, and the metal tacks used to secure the mesh during the prior surgery were in close approximation to the left phrenic neurovascular bundle (Fig 1). The metal tacks and the biologic mesh were carefully explanted (Fig 2). After mesh resection, the previous fundoplication was reversed and the recurrent HH was reduced. Further extensive mediastinal dissection was performed in order to mobilize the esophagus and obtain adequate intra-abdominal esophageal length. A modified partial, posterior 270° fundoplication was performed with gastropexy sutures and without mesh placement.

By the morning of post-operative day (POD) one, the patient reported significant improvement in his belching symptoms. A routine esophagram performed on POD one was negative for a leak and the patient was discharged home on POD two, with minimal belching. At a follow up visit, four weeks post-operatively the patient was noted to have complete resolution of his belching. He stated, “I feel back to 100%! You have given me my life back.”

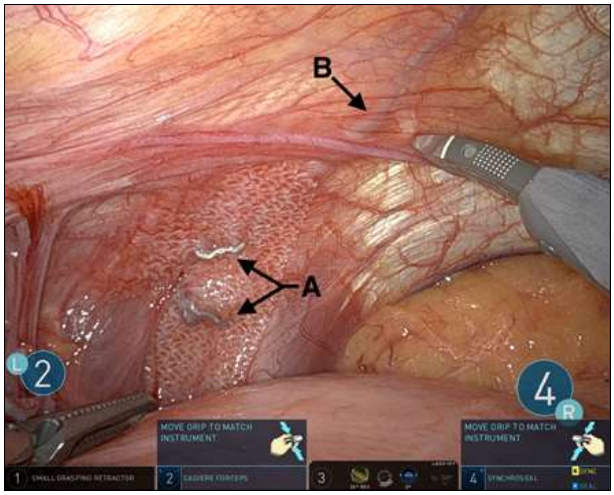

Fig 1: An intraoperative picture taken during the redo hiatal hernia repair showing the previously placed biologic mesh at the hiatus with metal staples in place. Note that the metal staples (A) are in close approximation to the course of the left phrenic neurovascular bundle (B).

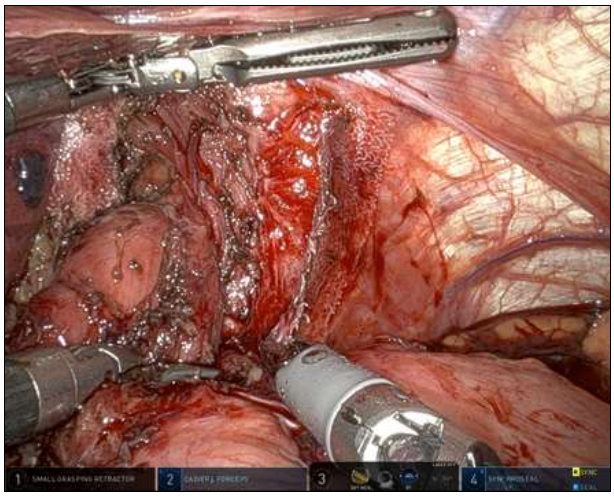

Fig 2: Intraoperative picture taken after tack removal and during mesh explanation

Discussion

Here we have described a case of surgically induced, neurogenic belching related to diaphragmatic tacks placed during a HH repair. The inability to belch is a known phenomenon that commonly occurs after HH repair and fundoplication, but an increase in belching after surgery is a highly unusual complication.

This patient’s belching is particularly notable because of its severity, occurring up to 20 times a minute, which caused a significant negative impact on his quality of life. This patient’s esophageal impedance study suggested supragastric belching, which typically has a delayed onset with a protracted course and is managed primarily with behavioral therapy. In retrospect, however, it is clear that

the patient did not have psychogenic supragastric belching but actually had a neurogenic belching that masked as supragastric belching. To our knowledge, this is the first report of a surgically-induced case of neurogenic, pseudo-supragastric belching related to phrenic nerve injury from a tack.

The phrenic nerve plays an important role in respiratory function due to its motor innervation of the diaphragm. Phrenic nerve injuries are a known cause of hiccups but less commonly associated with belching [7]. While not commonly reported after HH repair, phrenic nerve injury is a known complication after cardiac surgery [8]. Regardless, its anatomic proximity to the hiatus does put the phrenic nerve at risk during foregut surgery.

The surgical placement of diaphragmatic tacks is a described technique that surgeons occasionally employ to help fixate mesh around the diaphragmatic hiatus in an attempt to bolster a HH repair. However, diaphragmatic surgical tacks also do have some known complications, including migration through the diaphragm into the mediastinum or even penetrating cardiac injury causing pericardial tamponade [9]. Interestingly, uncontrollable belching has never been reported as a complication of diaphragmatic tack placement during HH repair. The Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) Guidelines state that tacks placed in the diaphragm can cause injury to the aorta or pericardium, however phrenic nerve injury is not mentioned [10]. Nonetheless, the avoidance of tacks in the diaphragm has previously been advocated [9]. This case underscores the importance of noting the diaphragmatic anatomy and of taking extreme care when using any mesh fixation technique during foregut surgery.

Conclusion

Surgical tacks placed near the phrenic nerve during upper gastrointestinal surgery are a rare cause of refractory belching. In this case, removal of the tacks provided complete symptomatic relief of this patient's life-limiting neurogenic pseudo-supragastric belching. Surgeons should take extreme caution when operating near the diaphragm and phrenic nerve. Additionally, instead of utilizing surgical tacks, alternative mesh fixation techniques should be considered during foregut surgery.

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