Abstract

Adolescent Rumination Syndrome (ARS) is a relatively uncommon disorder, defined by the involuntary regurgitation of recently ingested food from the stomach to the mouth, where it is either expelled or re-swallowed. Although the disorder itself is not life-threatening, it typically has a significant medical and psychosocial impact on the patient and family. There continues to be limited awareness about the clinical presentation, diagnosis, and treatment of ARS among clinicians. As such, adolescents presenting with symptoms of ARS often are misdiagnosed and typically undergo avoidable, extensive, invasive, and costly testing. This article seeks to increase awareness and knowledge about ARS, and to provide the clinician with practical guidelines regarding the pathogenesis, assessment, diagnosis, and treatment of ARS.
Adolescent Rumination Syndrome (ARS) is a relatively uncommon disorder, defined by the involuntary regurgitation of recently ingested food from the stomach to the mouth, where it is either expelled or reswallowed. Adolescent rumination is a functional gastrointestinal disorder (FGID) that is distinct from infantile rumination syndrome, which typically emerges between 3 and 6 months of age and often occurs in infants who are emotionally neglected. A limited awareness about the clinical presentation, diagnosis, and treatment of ARS among clinicians continues to be an issue. As such, adolescents presenting with symptoms of ARS are often misdiagnosed and typically undergo avoidable extensive, invasive, and costly testing. This, in turn, impacts the timeliness of treatment, with reports in the literature of adolescents with ARS experiencing symptoms an average of 21 to 77 months prior to obtaining a correct diagnosis. This is particularly concerning, as patients with rumination may experience secondary complications including weight loss, malnutrition, electrolyte imbalance, and functional impairment. Moreover, many patients experience distress and anxiety due to not having a diagnosis.

**DIAGNOSIS AND ASSESSMENT OF ARS**

The diagnosis of ARS is based on the Rome III diagnostic criteria for rumination syndrome (Table 1). As with most others FGIDs, in clinical practice, rumination often is a diagnosis of exclusion. In other words, efforts must be made to identify any underlying metabolic, infectious, neoplastic, and structural diseases that can present with chronic vomiting prior to making the diagnosis of ARS. In addition, ARS needs to be distinguished from other gastrointestinal diseases that also have regurgitation as a primary symptom, including gastro-esophageal reflux (GER), achalasia, gastroparesis, and cyclic vomiting syndrome. Radiographic contrast studies and an esophagogastrroduodenoscopy are usually necessary to identify structural and mucosal diseases, such as congenital anatomic defects or eosinophilic esophagitis. A 24-hour intra-esophageal monitoring for pH and impedance changes may be used to identify the pattern of reflux (occurring soon after eating and not at night in patients with ARS).

Despite the fairly broad differential diagnosis, the diagnosis of ARS can be made with confidence based solely on the clinical history. A test that often provides added diagnostic value is antro-duodenal manometry, an investigation that involves placement of a catheter through the nose into the stomach and small bowel in order to measure intraluminal pressure changes. Although manometry is not always necessary to diagnose ARS, it may serve as the “great convincer” when patients and their family require supporting evidence that ARS is the correct diagnosis. The manometric pattern associated with this condition is characterized by a sudden and brief rise in intra-gastric pressure (spikes known as “R waves”) generated by the contraction of the abdominal wall musculature, which precedes the retrograde intra-esophageal passage of gastric contents. Recent data have shown that the combined use of high-resolution manometry and stationary esophageal impedance also provide excellent diagnostic accuracy and may uncover subgroups of rumination in which the ingested material does not even reach the stomach before being regurgitated.
An important aspect of the diagnostic process is the observation of the patient’s vomiting behavior. Having the patient eat or drink while in clinic often provides useful information about the timing of rumination symptoms and the physical sensations experienced after the ingestion of food/fluid. The structure and complexity of the behavioral observation can vary depending on the clinical setting. At its simplest, a patient can be instructed to drink water at the start of a clinic visit, and at its most complex, a patient can be asked to eat a “typical meal” in which careful documentation of the amount and pace of food ingested, physical sensations, and timing of vomiting are recorded. Regardless of the structure or setting, all observations of vomiting behavior can provide information about the timing of regurgitation (ie, immediate versus non-immediate), the presence of retching or gagging, what the patient does with the regurgitated material (ie, reswallows or expels), and an in vivo description of the physical sensations the patient experiences prior to vomiting and after vomiting has occurred.

**CONTRIBUTING FACTORS TO THE PATHOGENESIS OF ARS**

**Etiological Factors**

Although the etiology of ARS remains equivocal, some evidence exists from patient histories that specific stressors may commence the patient’s rumination. From patient histories, some authors have reported an intercurrent viral illnesses or psychosocial stressor occurring at the same time the rumination began. In our experience, we have found 43% of patients reporting a viral illness co-occurring at the onset of rumination, 11% reporting a non-viral illness, 7% reporting an emotional stressor, 4% with a physical injury, 3% with a combination of stressors, and 32% unable to identify any specific stressor that may have been present. The presence of a stressor prior to symptom onset represents another commonality with other FGIDs, in which infections or stress seem to sensitize the gastrointestinal tract to the development of visceral hyperalgesia and long-term dysfunction.19

**Physiological Factors**

The act of rumination is driven by a rise in intra-abdominal and intra-gastric pressure associated with an untimely opening of the lower-esophageal sphincter (LES). At the same time, there may be an upward displacement of the esophago-gastric junction. These events lead to the reflux of the gastric contents into the esophagus.20, 21 However, the precise neuromuscular mechanisms generating the dysfunction of the gastro-esophageal junction during the rise in intra-gastric pressure remain unknown. An impaired gastric accommodation and a decreased visceral threshold for triggering a LES relaxation also have been demonstrated in adult patients with ARS.21 In contrast to what occurs in ruminant animals, there is no evidence of antiperistalsis in the human esophagus. Once the regurgitant reaches the oropharynx, most patients can make a conscious decision about whether to re-swallow or expel it.8 Many patients engage in both activities, depending on the social situation and amount of regurgitant at the time of rumination. Some adolescents with ARS carry a cup, bag, or other container where they spit out the gastric contents in the early post-prandial period.

**Sensation/Triggers**

As noted previously, patients often report additional somatic symptoms such as pain, bloating, reflux, or nausea prior to the onset of a rumination episode. The intensity of these symptoms often increases over a period of time, with peak discomfort occurring prior to the regurgitation of stomach contents, followed by immediate relief of the discomfort once the regurgitation has occurred.22 Recent research has identified a temporal link between the onset of dyspeptic and reflux symptoms after the ingestion of food/fluid and changes in intra-abdominal and intra-gastric pressure, suggesting that these sensations may function as a trigger for rumination behavior.18

It is unclear what mechanism drives the presence of such trigger symptoms. Adolescents with ARS tend to endorse multiple somatic complaints, particularly in response to stress.23 This is consistent with the literature on other FGIDs, which suggests that autonomic nervous system arousal in response to internal and/or external stressors may result in a decreased threshold for discomfort and changes in motility, which in turn results in the experience of dyspeptic symptoms.24

**Psychological Factors**

Our current understanding of the psychological profiles of patients with ARS is inadequate. In our experience, there is great variability in the psychological presentation of patients with ARS. Although ARS is not considered a mental...
health disorder, many patients with this condition also carry a diagnosis of a co-morbid mental health disorder such as depression or anxiety⁴,⁶, with one study reporting 51% of adolescents presenting for inpatient treatment of ARS having a mental health diagnosis.⁷ In that sample, patients were administered the MMPI-A (a standardized test for personality and psychopathology adapted for adolescents), and profiles were suggestive of a tendency to respond to stress with physiological symptoms.²³ It is unclear if the psychological features play a primary role in the development of ARS or are secondary to having a chronic, usually disabling condition. Regardless, the presence of these symptoms may mediate autonomic nervous system arousal by increasing sensitivity to stressors.²⁵

CONCEPTUAL MODEL OF ARS

As ARS is a FGID, it can be helpful to conceptualize it similarly to other FGIDs. A general model of the pathogenesis of FGIDs has been proposed in which various functional symptoms are the result of the braiding of physiological and psychological factors via the central and the enteric nervous system.²⁶ Disorder-specific models, such as for functional abdominal pain, have also been proposed that attempt to identify the specific components that contribute to the disorder and their inter-relationships.²⁴,²⁵ Based on available evidence and clinical experience, we have proposed a similar conceptual model of ARS in which physiological, sensory, and psychological factors interact to produce the ARS phenotype (Figure 1).

TREATMENT OF ARS

Medical Treatment

Because ARS is an FGID, it is not surprising that no medical treatment targeting the gastrointestinal tract is uniformly helpful. Most patients presenting with ARS have been treated in the past for possible GERD with gastric acid suppression. Failure to improve after this treatment is indeed part of the Rome III criteria for ARS. Because it is unusual for patients with ARS to develop peptic esophagitis, and due to the recent concerns about side effects related to chronic acid suppression,²⁷ proton pump inhibitors or histamine-2 receptor antagonists should not be used routinely in this patient population. Prokinetic medications — such as erythromycin, metoclopramide, domperidone, or bethanechol — also are often tried without much benefit. These medications may make symptoms worse by increasing the number and strength of gastric contractions, which may be perceived as noxious in patients who may already have some degree of visceral hyperalgesia and overall body hypervigilance.

The only medication that has been reported to be helpful in adults with rumination syndrome²⁸ is baclofen, a gamma-aminobutyric acid (GABA) B agonist that has also been found to be helpful in children with refractory GERD.²⁹ Baclofen reduces postprandial flow events (regurgitation or belching) by decreasing how often the LES relaxes, and it has been speculated that it may also reduce swallowing frequency, affect swallowing behavior, and impact primary vagal afferent nerves.³⁰,³¹

The main role of the physician in the care of adolescents with rumination is to make sure that the patients receive appropriate caloric intake, are adequately hydrated, and receive treatment for other symptoms that either coexist or precede the act of rumination. Special means of alimentation including the use of naso-gastric or naso-jejunal feeding tubes are often necessary in the early stages of rumination rehabilitation, as malnourished patients are usually not able to fully engage in the behavioral components of the treatment plan. We have found that many patients benefit from aggressive treatment of nausea with ondansetron or cyproheptadine, as well as from the use of tricyclic antidepressive agents that target visceral hyperalgesia. Sleeping disturbances, headaches, and abdominal bloating should also be treated accordingly.

Although anti-reflux surgery has been reported to be successful in a very small cohort of patients with rumination syndrome,³² surgical interventions are best avoided in a condition that has a significant behavioral component. Eliminating the ability of the patient to regurgitate will only change the symptom from ru-
mination to severe gagging and retching if the patient continues to contract the abdominal muscles and is unable to reduce the postprandial discomfort.

**Behavioral Treatment**

Several behavioral approaches aimed at ameliorating rumination symptoms have been discussed in the literature. One of the more common interventions discussed involves instruction in diaphragmatic breathing.33 Because rumination involves contraction of the abdominal wall, diaphragmatic breathing has been utilized to provide abdominal muscle relaxation. In addition, diaphragmatic breathing and other self-regulation strategies, such as progressive muscle relaxation, have been found to be beneficial for symptoms believed to trigger rumination.34 The use of biofeedback has been described by several authors as a beneficial adjunctive intervention to increase the patient’s awareness about their bodies’ response to stress and to develop self-regulation skills.1,4,6,22

As part of self-regulation, teaching patients how to re-swallow regurgitated material is an important aspect of treatment for several reasons. First, re-swallowing facilitates the patient’s ability to experience greater control over their physical response. Second, re-swallowing decreases the reinforcing quality of vomiting (ie, resolution of dyspeptic symptoms, nausea). Finally, by re-swallowing and not immediately experiencing relief, patients are exposed to the discomfort for a longer period of time and are able to use their self-regulation skills to manage the discomfort on their own.22

For many patients, ARS has been long-standing and had a detrimental impact on quality of life. Similar to other FGIDs, symptom maintenance is impacted by multiple factors, and therefore treatment must address the “big picture” in addition to specific symptoms at hand. To this end, we have created an interdisciplinary program that addresses all of the aforementioned treatment issues. Treatment involves disciplines such as gastroenterologists, pediatric psychologists, child life specialists, massage therapists, therapeutic recreation specialists, and a registered dietician. As such, all aspects of ARS are addressed in the inpatient setting, including medical (eg, malnutrition, dehydration, weaning from enteral feeds), behavioral (eg, the rumination response, self-regulation skills, refeeding), psychological (eg, anxiety, depression, stress), and general quality of life (eg, school re-entry, family relationships, peer relationships, physical conditioning). For the interested reader, the program and treatment aspects are well-described elsewhere.35

**CONCLUSION**

In summary, ARS is a FGID in which physiological, sensory, and psychological factors all contribute to the onset and maintenance of symptoms, which can be very disabling. Due to the rarity of the condition and perhaps minimal awareness among practitioners, patients often are subject to a delay in diagnosis and treatment. Treatment of ARS can be complex and challenging due to the multifaceted nature of the disorder and typically requires both medical and behavioral interventions. With greater awareness of the disorder and practitioners offering treatment, it is likely that a greater range of interventions will become available and empirically evaluated to determine the most efficacious interventions.

**REFERENCES**

18. Tucker E, Knowles K, Wright J, Fox MR.


