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ORIGINAL PAPERS

THE CARDIAC PARADOX OF LOSING WEIGHT: A REVIEW OF ROEMHELD GASTROCARDIAC SYNDROME

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Abstract. *This review highlights an uncommon yet reversible cause of reflex syncope that prevented an unnecessary pacemaker implantation. We present a rare instance of gastrocardiac syndrome, a frequently overlooked condition that links gastrointestinal disturbances with cardiac symptoms. This review underscores the importance of identifying modifiable causes of syncope before resorting to invasive treatments.*

Keywords: gastrocardiac syndrome, bradycardia, vagal response, syncope, intragastric balloon

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Introduction

Gastrocardiac syndrome, also known as Roemheld syndrome, describes the relationship between gastrointestinal disturbances and cardiac symptoms such as arrhythmias and syncope. This medical condition remains insufficiently understood. It is often overlooked in both cardiology and gastroenterology, despite increasing evidence linking gastrointestinal dysfunctions—such as gastroesophageal reflux disease (GERD), aerophagia, and hiatal hernias—to cardiac irregularities [1].

Ludwig Roemheld was the first to describe this condition, identifying the crucial role of the vagus nerve in triggering symptoms. Patients often suspect RS when they experience both cardiac and digestive symptoms simultaneously, such

as arrhythmia (irregular heartbeat), tachycardia (rapid heart rate), nausea, dizziness, chest pain, indigestion, gastric reflux, and bloating. In 1952, Ludwig von Roemheld first established the connection between cardiac symptoms and gastric pathology. He demonstrated that esophagogastric stimulation could induce arrhythmias, further supporting the link between the digestive system and heart function [2].

The underlying pathophysiology involves vagal nerve stimulation, which connects the gastrointestinal system to the heart. Excessive vagal activation can lead to bradycardia, atrial extrasystoles, or even vasovagal syncope [3]. Recent findings also suggest that certain weight-loss interventions, particularly intragastric balloon placement, may contribute to this syndrome by altering gastric tone and increasing vagal reflex activity [4].

A recent studyies of Bodur et al. (2021) explored the connection between premature atrial contractions (PACs) and gastroesophageal reflux disease (GERD). Their findings indicated that esophagitis and/or gastritis in individuals with GERD symptoms were independently linked to an increased prevalence of PACs. However, the precise mechanisms through which GERD contributes to supraventricular arrhythmias remain unclear. Several theories have been proposed, including alterations in autonomic nervous system balance and direct mechanical stimulation of the left atrium due to esophageal distension [5].

As a lesser-known condition, RS is often misdiagnosed as anxiety, panic attacks, or depression, although these can also be accompanying symptoms. Gaining a better understanding of this syndrome can help clarify the connection between the stomach and the heart, explaining why certain digestive issues may exacerbate cardiac symptoms.

Relevant Anatomy and Physiology

Research conducted by Dirk von Haehling and Stefan D. Anker discusses the interplay between gastrointestinal functions and cardiac health, highlighting how conditions like inflammatory bowel diseases can influence coronary heart disease risk [6].

Pradeep S. Rajendran and Kalyanam Shivkumar provides an in-depth review of how the parasympathetic nervous system, via the vagus nerve, influences heart rate, rhythm, and gastrointestinal activities [7].

Another work by Luis Ulloa and Theodoros Kelesidis explores the efferent pathways of the vagus nerve and its role in regulating gastrointestinal and hepatic functions [8].

Nachiket Patel et al. presents a clinical case highlighting the connection between gastrointestinal events and cardiac symptoms, emphasizing the role of autonomic nervous system interactions [9].

Proposed pathophysiological mechanisms

The precise etiopathogenesis of RS remains unclear. However, several mechanisms have been proposed. Esophageal reflux has been linked to an autonomic imbalance, characterized by increased vagal tone, which in turn may contribute to a higher susceptibility to arrhythmias [10].

Large hiatal hernias can directly compress the left atrium and the posterior wall of the left ventricle, thus favoring the occurrence of atrial arrhythmias and premature ventricular contractions (PVCs). Several studies have shown that extrinsic compression of the heart and pulmonary veins may be an important cause of dyspnea in these patients [11].

One study reported that 66% of patients with large hiatal hernias had moderate or severe compression of the left atrium, and over 40% had compression of the pulmonary veins. Symptoms resolved after surgery, confirming the correlation between cardiac compression and clinical manifestations [12].

Gastric distension can increase intra-abdominal pressure, pushing against the diaphragm and potentially altering the position of the heart within the thoracic cavity [13]. This shift may affect cardiac function by influencing mediastinal dynamics and intrathoracic pressure, which can contribute to sensations of chest discomfort or palpitations [14].

Vagal nerve activation due to gastric irritation or distension can lead to bradycardia or arrhythmias through excessive parasympathetic stimulation of the heart [15]. This vagal reflex is particularly relevant in conditions such as gastroesophageal reflux disease (GERD), where esophageal irritation can trigger autonomic responses affecting heart rate variability [16].

Chronic gastric inflammation and gastroesophageal reflux may contribute to cardiac symptoms via indirect mechanisms, including **autonomic nervous system dysregulation**, **systemic inflammation**, **and esophago-cardiac reflexes** [17]. Persistent gastric mucosal inflammation can lead to increased vagal tone and altered baroreceptor sensitivity, which may influence cardiac rhythm disturbances and exacerbate pre-existing cardiovascular conditions [18].

The Role of Gastrointestinal Factors in Arrhythmia

Arrhythmias, particularly supraventricular arrhythmias, can arise due to various contributing factors, including gastrointestinal conditions. Roemheld syndrome, also known as gastrocardiac syndrome, describes the relationship

between gastrointestinal symptoms and cardiac arrhythmias. Initially described by Ludwig Roemheld, subsequent studies have elaborated on this phenomenon [19].

Diagnosing Roemheld syndrome is complex due to its multifactorial nature. Potential mechanisms include excessive physical exertion, inflammation in the proximity of the esophagus and atria, autoimmune disorders, shared neural pathways, restricted coronary blood flow, and hiatal hernias [19]. Esophageal stimulation, whether mechanical or chemical through acid reflux, can enhance vagal nerve activity in patients with GERD-related arrhythmias. Increased vagal tone shortens atrial refractory periods, thereby promoting the development of atrial arrhythmias [20].

GERD also triggers the release of pro-inflammatory cytokines, such as interleukin (IL)-1b and IL-6, contributing to systemic inflammation. This inflammatory response may increase the risk of arrhythmias, particularly atrial fibrillation (AF). Acid reflux can lead to lower esophageal inflammation, which may extend through the esophageal wall, impacting the vagal nerves and potentially causing atrial myocarditis or local pericarditis [20]. Given the anatomical proximity of the esophagus to the atrium, disruptions in local receptors and reflex pathways can further exacerbate arrhythmic activity [19].

Clinical manifestations

Gastrointestinal Symptoms

Bloating, gastroesophageal reflux, dyspepsia, nausea.

Gastrointestinal symptoms like bloating and reflux are commonly associated with conditions such as **gastroesophageal reflux disease** (**GERD**), which occurs due to impaired lower esophageal sphincter function or abnormal esophageal motility [21]. These symptoms can lead to discomfort and even impact the quality of life.

Cardiac Symptoms

Arrhythmias (bradycardia, tachycardia), palpitations, atypical chest pain, dyspnea. Gastrointestinal conditions, particularly GERD and **gastric distension**, can trigger **vagal nerve stimulation**, which may lead to bradycardia, tachycardia, and other arrhythmias due to the vagus nerve's influence on heart rate regulation [22]. **Chest pain** may be a result of either **reflux** or **gastric distension** affecting mediastinal pressure, mimicking cardiac discomfort [23].

Neurovegetative Symptoms

Anxiety, panic attacks, sweating, dizziness. Conditions like GERD can be closely linked with **autonomic nervous system** dysfunction, leading to neurovegetative symptoms such as anxiety and panic attacks [24]. This can be due

to the brain-gut axis and the autonomic regulation of both gastric and cardiovascular function, where disturbances in one system can lead to symptoms in the other.

Aggravating Factors

Body position, large meals, fermentable foods. Certain physical positions, large meals, and foods that increase gastric acid secretion (e.g., spicy or fatty foods) can worsen symptoms in both the gastrointestinal and cardiovascular systems. [25] For example, **gastric distension** increases intra-abdominal pressure, which can exacerbate symptoms such as acid reflux and contribute to atypical chest pain [21].

Differential diagnosis

Roemheld Syndrome vs. Cardiovascular Diseases

The primary concern in differentiating Roemheld Syndrome (RS) from cardiovascular conditions is ruling out underlying heart disease.

Diagnostic tests such as electrocardiography (ECG), echocardiography, and Holter monitoring help exclude primary cardiac pathology [26].

GERD-related symptoms can mimic angina or palpitations, but their onset often correlates with food intake and body position, distinguishing them from true cardiac ischemia [27].

Roemheld Syndrome vs. Anxiety/Panic Disorders

Both RS and anxiety disorders involve autonomic nervous system dysregulation [24].

Hyperactivity of the vagus nerve in RS can lead to bradycardia and dizziness, whereas sympathetic activation in panic attacks more commonly causes tachycardia and hyperventilation [17].

Patient history and physiological responses (e.g., symptom resolution after gastric decompression) help distinguish RS from psychiatric conditions [23].

Other Gastrointestinal Causes Mimicking Roemheld Syndrome

Hiatal hernia: Alters intra-abdominal pressure and may cause chest discomfort and palpitations similar to RS [25].

Gastroesophageal reflux disease (GERD): Can cause vagal stimulation leading to cardiac-like symptoms such as bradycardia and arrhythmias [21].

Intestinal obstructions: Can lead to distension, triggering autonomic reflexes that influence cardiac function [17].

A hiatal hernia may physically compress the atrium, reducing cardiac blood supply and leading to ischemia, a condition that can induce arrhythmias. Additionally, a hiatal hernia can worsen acid reflux, further aggravating GERD symptoms [19].

Esophageal acid exposure has also been shown to affect coronary blood flow. Research indicates that acid instillation into the esophagus can reduce coronary circulation via autonomic reflexes. This mechanism has been suggested as a possible cause of Syndrome X, characterized by angina symptoms despite normal coronary arteries. Notably, this phenomenon is absent in heart transplant patients, reinforcing the theory that reduced coronary blood flow is mediated by a cardioesophageal reflex [28].

Diagnostic methods

Cardiological evaluation

A standard, non-invasive test used to evaluate heart rhythm and detect abnormalities that may be caused by vagus nerve-mediated reflexes. It is particularly useful in identifying bradyarrhythmias and premature atrial or ventricular contractions triggered by gastric distension [29].

This test provides continuous ECG monitoring over a full day, capturing transient arrhythmic events that may be linked to gastrointestinal triggers. It is beneficial in cases where symptoms are sporadic, helping to correlate arrhythmias with specific digestive activities, such as eating or lying down after meals [30]

Also known as an exercise ECG, this test assesses the heart's response to physical exertion, ruling out ischemic heart disease as a potential cause of symptoms. It is particularly important for differentiating between true cardiac ischemia and vagally mediated palpitations associated with Roemheld Syndrome [31].

A crucial imaging tool that evaluates cardiac structure and function. It can help detect valvular disorders, cardiomyopathies, and left ventricular dysfunction, all of which may present with symptoms mimicking gastrocardiac syndrome [32].

Gastroenterological evaluation

A direct visualization technique using an endoscope to examine the esophagus, stomach, and duodenum. It is primarily used to detect conditions such as GERD, peptic ulcers, and hiatal hernia, which may stimulate the vagus nerve and trigger cardiac symptoms [33].

A specialized test that measures esophageal peristalsis and the function of the lower esophageal sphincter (LES). It is particularly beneficial in diagnosing esophageal motility disorders, such as ineffective esophageal motility or

hypertensive LES, which can lead to prolonged esophageal distension and vagus nerve stimulation [34].

Testing for electrolytes imbalances

Magnesium plays a critical role in maintaining cardiac electrical stability. Hypomagnesemia has been associated with increased ventricular ectopy and atrial fibrillation. In patients with Roemheld Syndrome, monitoring magnesium levels is essential, as a deficiency can exacerbate arrhythmic tendencies [35].

Potassium is essential for maintaining the resting membrane potential of cardiac cells. Hypokalemia can lead to prolonged QT intervals and increased susceptibility to arrhythmias, while hyperkalemia may cause bradyarrhythmias and conduction blocks [36].

Calcium is fundamental for myocardial contraction and conduction. Both hypocalcemia and hypercalcemia can disrupt normal cardiac rhythm. Hypocalcemia has been associated with life-threatening ventricular arrhythmias, necessitating prompt correction of calcium levels to restore normal cardiac function [37]. Conversely, hypercalcemia can affect the electrical signals that control the heartbeat, potentially causing the heart to beat out of rhythm [38]. In the context of Roemheld Syndrome, calcium imbalance may amplify vagally mediated cardiac responses, necessitating careful evaluation of serum levels.

Therapeutic options and management

Proton pump inhibitors (PPIs), commonly used as first-line therapy for GERD, may also provide therapeutic benefits for patients with GERD-induced arrhythmias. Beyond suppressing gastric acid secretion through proton pump (K+-H+ ATPase) inhibition, PPIs exhibit antioxidant and anti-inflammatory properties. These effects suggest that PPIs could function as potential antiarrhythmic and cardioprotective agents due to similarities between gastric K+-H+ ATPase and cardiac proteins [19].

In cases where arrhythmias are suspected to be vagally induced, medications with vagolytic properties, such as quinidine and disopyramide, may be considered. These drugs help counteract excessive vagal stimulation while addressing the underlying gastrointestinal condition (Price, 2004).

Lifestyle Changes

Consuming smaller portions reduces gastric distension, minimizing excessive stimulation of the vagus nerve. Eating at regular intervals prevents large fluctuations in gastric volume and gas production, stabilizing digestion and reducing excessive vagal activation, which is known to contribute to transient bradycardia and cardiac irregularities [39].

Pharmacological Treatment

Proton Pump Inhibitors (PPIs)

These medications inhibit gastric acid secretion by blocking the hydrogen-potassium ATPase enzyme in the stomach lining. By reducing acid production, PPIs help alleviate reflux symptoms that can stimulate the vagus nerve, decreasing the likelihood of arrhythmic episodes associated with gastroesophageal irritation [40].

Surgical Interventions

Hiatal Hernia Repair: Surgical correction of a hiatal hernia can significantly reduce gastrocardiac symptoms by alleviating mechanical pressure on the diaphragm and vagus nerve, thereby decreasing the likelihood of vagally induced arrhythmias [41].

Fundoplication: Laparoscopic fundoplication remains the gold standard surgical procedure for patients with refractory gastroesophageal reflux disease (GERD), providing long-term symptom relief and reducing vagus nerve-mediated cardiac symptoms [42].

Gastric Bypass in Severe Cases: In patients with obesity-related GERD and vagus nerve dysfunction, Roux-en-Y gastric bypass has been shown to reduce both reflux episodes and associated cardiac arrhythmias, offering a metabolic and functional advantage over traditional antireflux surgery [43].

Research directions

Despite its clinical relevance, Roemheld Syndrome remains poorly studied, with most available data derived from case reports rather than large-scale trials. The absence of controlled studies makes it challenging to establish standardized diagnostic and treatment protocols [44].

Many patients with Roemheld Syndrome undergo unnecessary cardiac procedures due to the misattribution of symptoms to primary heart conditions. The development of standardized diagnostic criteria incorporating gastroenterological and cardiological assessments is crucial for accurate identification and management [45].

Given the overlap of symptoms between gastrointestinal and cardiac disorders, a multidisciplinary evaluation involving both specialties improves diagnostic accuracy and treatment outcomes. Studies suggest that integrated management reduces unnecessary interventions and improves symptom resolution [46].

Emerging treatments such as transcutaneous vagus nerve stimulation (tVNS) show promise in regulating autonomic dysfunction and reducing symptoms associated with excessive vagal activity. Clinical trials are ongoing to evaluate their efficacy in patients with vagally mediated arrhythmias [47].

Discussion

Gastrocardiac syndrome presents with a range of cardiac manifestations, including sinus bradycardia, atrial ectopy, and supraventricular tachycardia. These symptoms often stem from excessive vagal stimulation, which may be triggered by conditions such as GERD, aerophagia, or hiatal hernia [48]. The case described here further illustrates the role of gastric interventions, particularly intragastric balloon placement, in exacerbating vagal responses and cardiac symptoms.

The vagus nerve plays a critical role in autonomic regulation by transmitting signals between the gastrointestinal tract and the heart. Overactivation of this nerve can lead to excessive parasympathetic stimulation, resulting in decreased heart rate and, in some cases, vasovagal syncope [49]. Intragastric balloons, designed to aid weight loss by inducing early satiety, may also alter gastric motility and compliance, contributing to heightened vagal tone and cardiovascular instability [50].

Previous studies have reported cases of bradycardia, cardiac arrest, and even asystole following balloon placement, suggesting that these devices can significantly impact autonomic function [51]. It has also been observed that gastric volume expansion can trigger excessive vagal reflexes, potentially leading to prolonged parasympathetic stimulation even after balloon removal [52].

Conclusions

This report highlights the critical importance of considering reversible causes of reflex syncope before proceeding with permanent interventions such as pacemaker implantation. Gastrocardiac syndrome, though often underdiagnosed, can present with significant cardiac symptoms due to excessive vagal activation. In patients with a recent history of gastrointestinal interventions, careful assessment is essential to avoid unnecessary treatments. Future research should focus on understanding the long-term cardiovascular effects of intragastric balloons and other bariatric procedures to better manage potential complications.

A variety of physiological mechanisms may contribute to the development of arrhythmias in Roemheld syndrome. Clinicians should consider gastrointestinal factors when evaluating patients with unexplained arrhythmias. Further research is warranted to explore potential therapeutic strategies aimed at managing this complex interplay between GERD and cardiac rhythm disturbances.

Roemheld Syndrome is an underdiagnosed condition that significantly impacts patients' quality of life. A correct diagnosis requires the exclusion of

primary cardiac pathology, while treatment should be personalized, emphasizing dietary adjustments, gastroesophageal reflux management, and vagus nerve regulation.

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