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Gastroesophageal Reflux in Athletes: Impact on Performance and Non-Surgical Management Strategies

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Abstract

Introduction:

Gastroesophageal reflux disease (GERD) is a common gastrointestinal disorder that can negatively impact athletic performance. Symptoms such as heartburn, regurgitation, and chronic cough may limit exercise capacity and reduce training comfort. This study aims to present the effects of GERD on athletic performance and effective management strategies for athletes.

Methods:

A literature review was conducted, analyzing 31 scientific articles retrieved from PubMed and Google Scholar. The study examined GERD epidemiology, pathophysiological mechanisms, symptoms, and available treatment and lifestyle modification strategies.

Results:

GERD is more prevalent among athletes involved in endurance and strength sports, where intense exertion increases intra-abdominal pressure and weakens lower esophageal sphincter (LES) function. Symptoms can lead to reduced performance and exercise-related discomfort. Management strategies include dietary modifications, adjustments in exercise type and intensity, pharmacotherapy (proton pump inhibitors, prokinetic agents), and behavioral techniques such as stress control and sleep hygiene improvement.

Conclusions:

GERD poses a significant challenge for athletes, affecting their comfort and exercise capacity. Individualized management strategies, including dietary adjustments, tailored training modifications, and pharmacotherapy, can improve quality of life and sports performance. Further research is needed to better understand the impact of different physical activities on GERD and the efficacy of current treatment options.

Keywords: *GERD, gastroesophageal reflux, sport, athletic performance, management strategy, physical activity, diet, pharmacotherapy, pathophysiological mechanisms, symptoms, treatment*

Introduction

Gastroesophageal reflux disease (GERD) is one of the most common gastrointestinal disorders worldwide. GERD is characterized by the regular reflux of gastric contents into the esophagus, leading to bothersome symptoms and complications that can significantly reduce patients' quality of life. If left untreated, GERD carries the risk of severe complications, such as Barrett's esophagus, a precancerous condition, and esophageal adenocarcinoma, one of the most aggressive cancers. [1] Given the increasing global prevalence of GERD, understanding its epidemiology is crucial for developing effective treatment methods and preventive strategies. [2,3]

Epidemiology

The global prevalence of GERD is estimated to be around 10-15% of the adult population [3]. However, epidemiological data indicate significant geographical differences in GERD symptom occurrence.

The highest prevalence is observed in South Asia and Southeastern Europe, where GERD symptoms affect over 25% of the population, whereas the lowest prevalence is found in Southeast Asia, Canada, and France, where the rate does not exceed 10% [4]. Studies conducted in various countries also reveal considerable variability in symptom prevalence. For instance, in Japan, GERD symptoms occur in 13% of the population monthly, whereas in Finland and Norway, prevalence ranges from 21% to 31%. [5] In the United States, approximately 20% of adults report GERD symptoms, while in Europe, the prevalence of gastroesophageal reflux symptoms varies between 17% and 45%. [3,5]

GERD is also a common health issue among athletes, particularly those participating in endurance sports such as running, cycling, and swimming. Intense physical exertion, especially during prolonged and high-intensity exercise, may lead to the exacerbation of GERD symptoms. [6]

Risk Factors

Gastroesophageal reflux disease (GERD) is a gastrointestinal disorder whose development is associated with multiple risk factors, including lifestyle and dietary factors, anatomical abnormalities, and genetic predisposition. Understanding these factors is crucial for effective prevention and treatment of the disease. [7,8,9]

Lifestyle and Dietary Factors

Obesity is one of the most significant risk factors for GERD. Excess body weight, particularly abdominal obesity, is strongly linked to an increased risk of developing gastroesophageal reflux. A higher body mass index (BMI) correlates with the severity of GERD symptoms, as increased intra-abdominal pressure promotes the reflux of gastric contents into the esophagus.

Smoking is another factor that significantly increases the risk of developing GERD. The chemicals in cigarette smoke weaken the lower esophageal sphincter (LES), facilitating gastric reflux. Additionally, smoking can lead to increased gastric acid secretion, further exacerbating reflux symptoms. [7,8,9]

Alcohol consumption is also associated with GERD symptoms. Like nicotine, alcohol weakens the function of the LES, allowing stomach acid to reflux into the esophagus. Moreover, alcohol can irritate the esophageal mucosa, worsening GERD symptoms. [9]

Physical activity after meals and intense exercise may contribute to the development of GERD symptoms. Specifically, activities that increase intra-abdominal pressure can exacerbate GERD symptoms in affected individuals. On the other hand, regular moderate physical activity has a positive impact on weight management, which may ultimately reduce GERD severity and improve overall health. [9,7]

Diet plays a significant role in GERD development. Consumption of fatty, fried, acidic, and spicy foods, as well as fruit juices (such as orange and grapefruit juice), tomatoes and tomato-

based products, chocolate, coffee, tea, carbonated beverages, and alcohol, can trigger GERD symptoms. Additionally, irregular meal consumption, large meal portions, and eating shortly before bedtime are factors that may correlate with increased reflux severity. [9]

Certain medications can also increase the risk of GERD by affecting LES function and digestive processes. These include nonsteroidal anti-inflammatory drugs (NSAIDs), acetylsalicylic acid (ASA), hormone replacement therapy (HRT), bisphosphonates, calcium channel blockers, nitrates, antidepressants, anticholinergics, and theophylline. [10]

Anatomical Abnormalities

Significant anatomical abnormalities that may contribute to GERD development include hiatal hernia. This condition occurs when part of the stomach moves into the chest cavity through the esophageal hiatus in the diaphragm, disrupting normal LES function and facilitating reflux.

Genetic Factors

Genetic factors also play a role in GERD development. Twin and family studies have shown that the heritability of GERD is approximately 31% [7]. Additionally, numerous single nucleotide polymorphisms (SNPs) in various genes, such as FOXF1, MHC, CCND1, anti-inflammatory cytokine genes, and DNA repair genes, have been strongly associated with an increased risk of GERD. These polymorphisms can influence gastrointestinal function, oxidative stress response, and inflammatory processes, ultimately leading to the exacerbation of reflux symptoms. [7,8]

Other Risk Factors

Other factors that may increase GERD risk include stress, depression, short sleep duration, and metabolic syndrome [7,8,10]. Stress and depression can affect gastrointestinal function by disrupting gut motility and altering the body's response to external stimuli. [8] Metabolic syndrome, which includes obesity, hypertension, hyperglycemia, and dyslipidemia, is also a predisposing factor for GERD, as it is associated with dysfunctions in multiple bodily systems, including the digestive system [7,10].

Pathophysiological Mechanisms

Gastroesophageal reflux disease (GERD) is a disorder with a complex and not yet fully understood etiopathogenesis. It is believed that its development is associated with an imbalance between esophageal damaging factors and defensive mechanisms. [11,12,13,14]

Dysfunction of the Anti-Reflux Barrier at the Esophagogastric Junction

A key role in GERD pathogenesis is played by the dysfunction of the anti-reflux barrier at the esophagogastric junction (EGJ), which consists of the lower esophageal sphincter (LES) and anatomical structures of the diaphragm [11,12,13,14]. Reduced LES pressure, which under normal conditions ranges from 15 to 30 mmHg above intragastric pressure, promotes the reflux

of gastric contents into the esophagus [13,14]. Factors that weaken LES tone include certain hormones, medications, consumption of high-fat foods, chocolate, caffeine, excessive alcohol intake, and smoking [13]. A significant pathological mechanism is transient lower esophageal sphincter relaxations (TLESRs), which are spontaneous, swallowing-independent episodes of reduced LES pressure that can last from 10 to 45 seconds. These are the most common cause of reflux [11,12,13,14].

The frequency and duration of TLESRs are increased in GERD patients, and these episodes are often accompanied by acidic gastric content reflux [11]. In patients with hiatal hernia (HH), where part of the stomach moves into the chest cavity, LES function is further weakened, increasing the likelihood of reflux even with a slight decrease in LES pressure [11,12,13,14].

Esophageal Clearance Disorders

Another crucial factor in GERD pathogenesis is impaired esophageal clearance, which is responsible for removing refluxed material and neutralizing hydrochloric acid. These mechanisms include esophageal peristalsis and saliva production. Esophageal motility disorders, referred to as ineffective esophageal motility (IEM), lead to delayed esophageal clearance and prolonged mucosal contact with gastric contents. Additionally, saliva, which contains bicarbonates, plays a crucial role in hydrochloric acid neutralization. Reduced saliva production, such as in xerostomia, may exacerbate GERD symptoms. [11,12,13,14]

Gastric Motility Disorders

Gastric motility also plays a significant role in GERD, particularly delayed gastric emptying, which leads to excessive stomach filling and an increased frequency of TLESRs. Disorders of gastric accommodation, or the improper relaxation of the stomach's upper part after a meal, may further contribute to reflux. [11,12,13,14]

Characteristics of Refluxed Gastric Contents

The composition of refluxed gastric contents is another key factor in GERD pathogenesis. Acidic reflux containing hydrochloric acid, pepsin, and, in some cases, bile and pancreatic enzymes contributes to esophageal mucosal damage. Although hydrochloric acid is considered the primary irritant, the presence of bile components can exacerbate mucosal injury, particularly in cases resistant to treatment. [11,12,13,14]

Esophageal Mucosal Defense Impairments

The protection of the esophageal mucosa against refluxed contents depends on its integrity and regenerative capacity. Increased epithelial permeability and widening of intercellular spaces heighten susceptibility to damage, contributing to GERD symptoms. [11,12,13,14]

Visceral Hypersensitivity

Visceral hypersensitivity in some patients can lead to an exaggerated perception of discomfort, even with physiological levels of reflux. This mechanism is associated with increased

sensitivity of esophageal nerves to chemical (acid), mechanical (distension), and thermal stimuli. Psychological factors, such as stress, anxiety, and depression, can further amplify symptom perception. [11,12,13,14]

Symptoms

Esophageal Symptoms	Extraesophageal Symptoms
Heartburn	Chronic cough
Acid regurgitation	Asthma
Epigastric pain	Laryngitis
Dyspepsia	Dental erosions
Nausea	Bronchospasm
Bloating	Wheezing
Belching	Hoarseness
Epigastric fullness	Sore throat
Epigastric pressure	Globus sensation
Chest pain	Idiopathic pulmonary fibrosis
Dysphagia	
Bleeding	

TABLE 1. Esophageal and Extraesophageal Symptoms [15,16,17,18,19]

Physical Activity as a Risk Factor

Symptoms of gastroesophageal reflux disease (GERD), such as heartburn (burning sensation behind the sternum) and regurgitation (the backflow of gastric contents into the esophagus or mouth), can significantly impact the ability to perform physical exertion and overall physical performance [6]. In addition to typical esophageal symptoms, GERD is often associated with extraesophageal manifestations [13,14]. These nonspecific symptoms can be misinterpreted as exercise-induced respiratory problems, further complicating diagnosis and treatment [6]. Chronic and persistent cough, in particular, can limit the ability to breathe efficiently during exercise, leading to faster fatigue and reduced athletic performance. Similarly, reflux-induced dyspnea can cause discomfort and restrict the intensity of physical activity [13].

Intense physical exertion can exacerbate GERD symptoms. Experimental studies suggest that during strenuous aerobic exercise, especially at intensities exceeding 70% of maximal oxygen uptake (VO2max), there is an increase in the number of reflux episodes, prolonged episode duration, and a decrease in esophageal pH below 4 for extended periods. These changes may be associated with increased intra-abdominal pressure, hormonal fluctuations, and reduced

gastrointestinal blood flow during intense exercise. Moreover, physical activity can influence the function of the lower esophageal sphincter (LES), which plays a key role in preventing reflux. Changes in LES tone due to exertion may facilitate the backflow of gastric contents into the esophagus. [6,11,12,13,14]

Not all types of physical activity contribute equally to the onset or worsening of reflux. Activities involving body oscillations and mechanical shocks, such as running, may promote reflux mechanically. While running, continuous jolts may increase gastric pressure and facilitate the backflow of stomach contents into the esophagus. Strength training, particularly exercises that heavily engage abdominal muscles and lead to significant increases in intra-abdominal pressure (e.g., weightlifting), can also exacerbate reflux symptoms. Similarly, contact sports, where abdominal impact occurs, may increase the risk of reflux.

Additionally, certain body positions adopted during physical activity can promote reflux. Bent or prone positions, commonly seen in surfing, can impair proper LES function and increase the risk of gastric content backflow. Likewise, the bent-over position characteristic of cyclists may contribute to the worsening of reflux symptoms.

However, it is important to note that moderate physical activity can have beneficial effects in reducing reflux symptoms for some individuals. For example, walking and chewing gum after meals may reduce postprandial acid reflux. Therefore, individual adjustment of the type and intensity of physical activity is crucial for individuals suffering from GERD [6].

Management Strategies for GERD in Athletes

Dietary Modifications

Dietary modifications play a crucial role in alleviating the symptoms of gastroesophageal reflux disease (GERD) in athletes. To minimize the risk of discomfort, it is recommended to avoid foods and beverages that may exacerbate reflux symptoms. These include fatty and fried foods, chocolate, coffee, and other caffeine-containing beverages. Additionally, carbonated drinks, spicy foods, tomatoes and tomato-based products, citrus fruits and juices, and alcohol should be excluded, as they can weaken the lower esophageal sphincter (LES) and promote gastric content reflux. [15,20,21,22,23]

Proper meal timing before training is equally important. Large meals should be avoided for 2–3 hours before physical activity, as they can cause a feeling of fullness and increase reflux risk. In cases where pre-exercise food intake is necessary, smaller, easily digestible snacks consumed closer to training may be better tolerated. Liquid meals, which are well tolerated and pre-tested by the athlete, can also be a beneficial option before and during training or competition, reducing the likelihood of discomfort. Solid foods should be avoided for at least three hours before physical exertion. [21]

Training Modifications

Introducing modifications in training can also help reduce reflux symptoms in athletes. Individuals experiencing GERD should select physical activities that minimize pressure on the stomach. It is particularly advisable to avoid exercises that increase intra-abdominal pressure, such as intense weightlifting and sprinting, as these may worsen reflux symptoms. [22,24]

Another essential aspect is avoiding positions that promote gastric content reflux into the esophagus. In particular, athletes should limit forward bending and avoid lying down immediately after meals. [24]

Pharmacological Treatment

Gastroesophageal reflux disease (GERD) is a chronic condition characterized by the backflow of gastric contents into the esophagus, leading to unpleasant symptoms such as heartburn, chest pain, and regurgitation. In athletes, GERD can negatively impact physical performance and training comfort, making effective treatment essential. Pharmacotherapy serves as the primary management approach for GERD, aiming to reduce gastric acid secretion, improve gastrointestinal motility, and protect the esophageal mucosa. [15,25,26]

Acid-Suppressing Medications

The primary treatment strategy for GERD involves the use of medications that decrease gastric acid secretion. These include:

1. Proton Pump Inhibitors (PPIs) – The most effective drugs for GERD therapy, as they inhibit the H^+/K^+-ATPase enzyme (the so-called proton pump) in gastric parietal cells, leading to prolonged acid suppression.
   - Studies show that approximately 83% of GERD patients and 78% of those with erosive esophagitis respond positively to PPI therapy.
   - Advanced formulations, such as delayed-release dexlansoprazole (MR), provide prolonged therapeutic effects, which may be beneficial for athletes requiring flexible dosing.
   - Extended-release rabeprazole (ER) may offer more effective and prolonged acid suppression than some other PPIs.
2. H2 Receptor Antagonists (H2RAs) – These drugs inhibit acid secretion by blocking histamine receptors in the stomach. Although they are less effective than PPIs, they may serve as adjunct therapy, particularly for nighttime GERD symptoms. [15]
3. Potassium-Competitive Acid Blockers (P-CABs) – A newer class of drugs, including vonoprazan, which provides a faster onset of action and may be effective in cases resistant to PPIs. [15,25,26]

Management of Refractory GERD Symptoms

Approximately 30% of GERD patients continue to experience symptoms despite PPI therapy. In such cases, the following strategies are employed:

- Increasing PPI dosage – Doubling the dose to twice daily may improve acid control.
- Adding H2RA at night – This may reduce nighttime reflux episodes, although there is a risk of developing tolerance to these drugs.
- Medications reducing transient LES relaxations (TLESR) – Agents such as baclofen can decrease reflux episodes, but their use in athletes requires caution due to potential side effects like drowsiness and weakness.
- Prokinetic agents – Drugs such as mosapride and itopride enhance gastrointestinal motility and may support GERD treatment when combined with PPIs.
- Mucoprotective agents – Sucralfate, alginates, and formulations containing hyaluronic acid and chondroitin sulfate create a protective barrier on the esophageal mucosa, reducing reflux-related damage. [15,25,26]

Considerations for Pharmacotherapy in Athletes

The management of GERD in athletes requires special attention, as some medications may affect performance and training comfort. For instance:
- Baclofen, despite its effectiveness in reducing reflux episodes, can cause weakness and drowsiness, potentially impairing athletic performance.
- PPIs, while highly effective, may impact the absorption of essential micronutrients such as magnesium and calcium, which are crucial for athletes prone to injuries and electrolyte imbalances.
- Drug interactions with dietary supplements used by athletes can influence their efficacy or safety.

Additionally, ensuring compliance with anti-doping regulations is vital, necessitating consultation with a physician or sports medicine expert. [15,25]

Behavioral Strategies

Behavioral interventions can serve as valuable adjuncts to other GERD management strategies, as psychological factors and lifestyle choices also influence symptom severity [27,28]. Stress control is a key component, as anxiety and stress can exacerbate symptoms by affecting gastrointestinal motility and pain perception. Stress reduction techniques such as meditation, yoga, relaxation training, and cognitive-behavioral therapy may help decrease the frequency and severity of reflux episodes. [29]

Breathing techniques, especially diaphragmatic breathing exercises, may influence intra-abdominal pressure and LES function. Although these exercises show potential benefits in reflux symptom control, further research is needed to evaluate their efficacy in athletes. [21]

Improving sleep hygiene is another critical behavioral strategy. Sleep deprivation and poor sleep quality can negatively impact digestive function and overall health. Ensuring adequate sleep duration and maintaining a consistent sleep schedule supports better reflux symptom control. Avoiding meals and large fluid intakes shortly before bedtime, as well as elevating the head of the bed, can help reduce nighttime reflux. [30,31]

Conclusion

Gastroesophageal reflux disease (GERD) poses a significant challenge for athletes, particularly in endurance sports where intense physical exertion can exacerbate symptoms. The impact of GERD on athletic performance is linked to mechanisms such as increased intra-abdominal pressure, LES dysfunction, and delayed gastric emptying. Symptoms such as heartburn, acid regurgitation, and chronic cough can severely limit exercise capacity and, in extreme cases, prevent athletes from competing.

Effective GERD management in athletes requires an individualized approach, incorporating dietary modifications and proper training planning. Avoiding large meals before exercise and eliminating trigger foods such as fatty and acidic foods, carbonated drinks, and caffeine are essential. Additionally, exercise type and intensity should be tailored to individual predispositions, and in some cases, training modifications may be necessary.

Pharmacotherapy plays a crucial role in symptom relief, with PPIs remaining the most effective treatment option. However, their use in athletes requires consideration of potential side effects, such as nutrient malabsorption and drug-supplement interactions. Prokinetic, mucoprotective, and TLESR-reducing agents may be effective for refractory symptoms.

Behavioral strategies, including stress reduction, sleep hygiene improvement, and breathing exercises, also contribute to GERD management. Incorporating these elements into an athlete's daily routine can enhance both quality of life and training efficiency.

Despite increasing research on GERD in athletes, further studies are needed to better define the impact of different physical activities on symptom severity and the efficacy of various therapeutic strategies. A deeper understanding of these mechanisms can optimize both GERD prevention and treatment in the sports context, ensuring sustained high physical performance in professional and recreational athletes.

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