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## THE ROLE OF ANATOMICAL AND HORMONAL FACTORS IN THE PATHOGENESIS OF VARICOCELE IN CHILDREN AND METHODS FOR ITS PREVENTION (LITERATURE REVIEW)

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### Abstract:

Varicocele, a common condition in adolescent males, is characterized by the dilation of the pampiniform plexus veins and is associated with potential impacts on testicular growth, hormone production, and fertility. The pathogenesis of varicocele involves both anatomical and hormonal factors, including venous insufficiency, impaired testicular temperature regulation, oxidative stress, and inflammatory cytokine activity. Hormonal alterations, such as reduced testosterone and inhibin B levels, further contribute to testicular dysfunction. Management strategies range from observation and monitoring to surgical interventions like microsurgical varicocelectomy, laparoscopic repair, and percutaneous embolization. Early detection and appropriate treatment are essential to prevent long-term reproductive consequences.

**Keywords:** varicocele, adolescent males, testicular function, oxidative stress, varicocelectomy

### Introduction

Varicocele, a condition characterized by the dilation of the pampiniform plexus veins, is a common issue in adolescent males, with a prevalence of approximately 15% [1] [3]. It is associated with potential impacts on testicular growth, hormone production, and future fertility. This response explores the anatomical and hormonal factors involved in the pathogenesis of varicocele in children and discusses methods for its prevention.

### Anatomical Factors in Varicocele Pathogenesis

#### Venous Insufficiency and Testicular Temperature Regulation

The primary anatomical factor in varicocele development is venous insufficiency, which leads to impaired blood flow and increased hydrostatic pressure in the testicular veins [5] [9]. This venous dilation disrupts the counter-current heat exchange mechanism, resulting in elevated testicular temperatures. Elevated temperatures can impair spermatogenesis and testicular function, contributing to the pathogenesis of varicocele [17].

#### Testicular Atrophy and Asynchronous Growth

Varicocele is often associated with ipsilateral testicular atrophy, which may be due to reduced blood flow and oxidative stress [12] [15]. Asynchronous testicular growth, where the affected testis is smaller than the contralateral one, is a common finding in adolescents with varicocele. This discrepancy may persist into adulthood if left untreated [3] [16].

### **Impact on Spermatogenesis**

The anatomical abnormalities in varicocele can lead to impaired spermatogenesis, characterized by reduced sperm count, motility, and morphology [6] [18]. These changes are thought to result from oxidative stress, inflammation, and heat-induced damage to the germinal epithelium [5] [9].

### **Hormonal Factors in Varicocele Pathogenesis**

#### **Testosterone and Gonadotropin Levels**

Hormonal alterations, particularly in testosterone levels, have been observed in adolescents with varicocele. Lower levels of free testosterone (FT) and total testosterone (TT) are associated with higher grades of varicocele [1]. These hormonal changes may contribute to impaired testicular function and spermatogenesis [12].

#### **Inflammatory Cytokines and Oxidative Stress**

Varicocele is associated with increased levels of pro-inflammatory cytokines such as IL-1 $\beta$ , IL-6, and TNF $\alpha$ , which contribute to endothelial dysfunction and chronic inflammation [5]. These inflammatory processes exacerbate oxidative stress, further impairing testicular function [9].

#### **Role of Inhibin B and FSH**

Inhibin B, a marker of Sertoli cell function, is often reduced in patients with varicocele, indicating impaired testicular growth and development [8] [12]. Elevated follicle-stimulating hormone (FSH) levels may also be observed, reflecting compromised spermatogenesis [1] [3].

### **Methods for Prevention and Management**

#### **Observation and Monitoring**

For asymptomatic patients with mild varicocele, observation and regular monitoring are often recommended. This approach involves serial ultrasound measurements of testicular volume and semen analysis to assess for any signs of testicular dysfunction [3] [16].

#### **Surgical Intervention**

Surgical intervention is indicated in cases of significant testicular atrophy, persistent pain, or abnormal semen parameters. Microsurgical varicocelectomy is the preferred technique due to its high success rate and low complication profile [4] [9]. This procedure involves the ligation of dilated veins while preserving the testicular artery and lymphatic vessels.

#### **Minimally Invasive Techniques**

Laparoscopic and percutaneous embolization techniques are alternative approaches for varicocele treatment. These methods are less invasive and

may reduce the risk of postoperative complications such as hydrocele [10] [16].

### Hormonal and Medical Therapy

In some cases, medical therapy may be considered to address hormonal imbalances or inflammation. Anti-inflammatory agents and antioxidants have been used to mitigate oxidative stress and improve testicular function [6] [9].

**Table: Comparison of surgical techniques for varicocele repair**

Technique	Description	Advantages	Citation
Microsurgical Varicocelectomy	Subinguinal approach with magnification to ligate dilated veins	High success rate, minimal complications, preservation of testicular artery	[4] [9]
Laparoscopic Varicocelectomy	Minimally invasive approach using laparoscopic instruments	Reduced postoperative pain, shorter recovery time	[10] [16]
Percutaneous Embolization	Radiological occlusion of dilated veins	Less invasive, reduced risk of hydrocele	[10] [16]

### Conclusion

Varicocele in children and adolescents is influenced by both anatomical and hormonal factors, including venous insufficiency, testicular atrophy, and inflammatory cytokine production. Early intervention, whether through observation or surgical correction, is critical to preserve testicular function and future fertility. Further research is needed to establish definitive guidelines for the management of varicocele in pediatric populations.

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