

Understanding Peyronie's Disease: From Microtrauma to Fibrotic Plaque Formation

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ABSTRACT

Peyronie's disease (PD) is a fibrotic disorder of the tunica albuginea, characterized by penile plaque formation, curvature, pain, and sexual dysfunction. PD is a benign disorder characterized by a plaque made of fibrosis of the tunica albuginea, leading to penile curvature, pain, and erectile dysfunction, with significant emotional impact. This plaque may affect the length on the affected side during the erection resulting in the curvature of the penis and possible deformity associated with other symptoms such as discomfort, pain and erectile dysfunction. The disease progresses through two phases: an acute phase marked by inflammation and plaque development, and a chronic phase where pain subsides but deformity stabilizes or worsens. Understanding natural evolution and pathophysiology is crucial for guiding treatment and improving patient outcomes.

KEYWORDS: Benign disorder, tunica albuginea, microtrauma, plaque, fibrosis.

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INTRODUCTION

PD was first described in 1743 by Francois Gigot de la Peyronie of France, after whom the disease is named. PD has a higher prevalence in those with erectile dysfunction (ED), diabetes, or cardiovascular disease. The pathophysiology of PD summarizes aberrant wound healing in the tunica albuginea, triggered by repetitive microtrauma during sexual activity, penile surgery or prostatectomy, either one that results in a trauma of the tunica albuginea, but also some risk factors that summarize in a reduced perfusion of the penis and hereditary conditions, and also the neoangiogenesis induced by hypoxia response.

RISK FACTORS

There are several risk factors that reduce de perfusion to the penis, leading to negative penile healing. These risk factors include diabetes mellitus, hypertension, hyperlipidemia, heart disease and smoking.

INFLAMMATORY RESPONSE

Microtraumas during sexual activity, penile trauma, penile surgery or prostatectomy, which causes trauma to the tunica

albuginea, release damage-associated molecular patterns (DAMPs), activating toll-like receptors (TLRs) on immune cells. This triggers proinflammatory cytokines such as IL-1 β , IL-6, TNF- α primarily and recruits fibroblasts. This results in an impaired tissue response leading to increased profibrotic factors and decreasing antifibrotic factors. The transforming growth factor-beta 1 (TGF- β 1) promotes myofibroblast differentiation, leading to excessive collagen deposition and plaque formation. TGF- β 1 also upregulates tissue inhibitors of metalloproteinases (TIMPs), impairing extracellular matrix (ECM) remodeling. The oxidative stress plays an important role in PD pathogenesis through reactive oxygen species (ROS), generated via NADPH-oxidase, exacerbating fibrosis by sustaining inflammation and ECM damage.

ANGIOGENESIS

Neoangiogenesis is induced by hypoxia, hypoxia-induced factors like vascular endothelial growth factor (VEGF) stimulate neoangiogenesis, through the release of hypoxia-inducible factor 1 which results in a fibrogenic response.

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GENETIC FACTORS

Several hereditary factors may predispose individuals to PD, such as the G915C SNP in TGF- β 1, which enhances fibrotic activity. Additionally, downregulation of antifibrotic genes (e.g., SMAD7) and upregulation of profibrotic genes like pleiotrophin or the Monocyte Chemoattractant Protein-1 (MCP-1) have been observed in PD plaques compared with healthy tunica albuginea.

CONCLUSION

Peyronie's disease (PD) is a complex fibrotic disorder of the tunica albuginea, characterized by penile plaque formation, curvature, pain, and sexual dysfunction. Its pathophysiology involves a cascade of events triggered by microtrauma, impaired wound healing, and dysregulated inflammatory responses. Key mechanisms include the activation of pro-fibrotic pathways mediated by TGF- β 1, oxidative stress via ROS, and hypoxia-induced neoangiogenesis. These processes lead to excessive collagen deposition, plaque formation, and penile deformity, significantly impacting patients' physical and psychological well-being. PD progresses through distinct phases: an acute inflammatory phase with dynamic symptoms and a chronic phase where deformities stabilize but often persist. Risk factors such as diabetes, cardiovascular disease, and genetic predispositions (e.g., TGF- β 1 polymorphisms) exacerbate the condition by impairing tissue repair and promoting fibrosis. Effective management requires a multidisciplinary approach, combining patient education, conservative therapies (e.g., NSAIDs, CCh injections), and

surgical interventions for advanced cases. Early diagnosis and tailored treatments are crucial to mitigate symptoms and improve quality of life. Future research should focus on targeted antifibrotic therapies and personalized medicine to address the underlying molecular mechanisms.

REFERENCES

- I. Di Maida F, Cito G, Lambertini L, Valastro F, Morelli G, Mari A, et al. The Natural History of Peyronie's Disease. *World J Mens Health*. 2021 Jul;39(3):399-405. doi: 10.5534/wjmh.200065.
- II. Li EV, Esterguest R, Pham MN, Panken EJ, Amarasekera C, Siebert A, et al. Peyronie's disease: pharmacological treatments and limitations. *Expert Rev Clin Pharmacol*. 2021;14(4):1-12. doi: 10.1080/17512433.2021.1903873.
- III. Chung PH, Han TM, Rudnik B, Das AK. Peyronie's disease: what do we know and how do we treat it? *Can J Urol*. 2020;27(Suppl 3):11-19.
- IV. Sandean, D., Leslie, S., & Lotfollahzadeh, S. (2024). Peyronie disease. *StatPearls*.
- V. Palawan, H., & Sheriff, D. S. Peyronie's Disease: A Literature Review On Epidemiology, Genetics, Pathophysiology, Diagnosis and Work-Up. *alcohol*, 7, 8.
- VI. Palumbo, F., Sebastiani, F., Procacci, A., D'Altilia, N., Ricapito, A., & Cormio, L. (2022). Peyronie's disease. In *Practical Clinical Andrology* (pp. 61-73). Cham: Springer International Publishing.