



REVIEW

A thorough examination of the causes, diagnosis, and treatment of erectile dysfunction: A comprehensive review

Muhammad Fauzan Farhat

ABSTRACT

Background: Erectile dysfunction (ED) is a complex sexual disorder and a significant clinical indicator of vascular, metabolic, endocrine, neurological, psychological, and relational health. This brief narrative review encapsulates the prevailing evidence regarding the etiology, diagnosis, and treatment of erectile dysfunction (ED).

Methods: From 2016 to 2026, we gave priority to peer-reviewed guidelines, consensus statements, systematic reviews, meta-analyses, and high-impact reviews.

Results: The evaluation of ED should incorporate a sexual and medical history, a validated symptom assessment, a focused examination, selective laboratory testing, and cardiovascular risk assessment. The primary treatment continues to focus on lifestyle enhancement and phosphodiesterase type 5 inhibitors. Conversely, vacuum devices, localized vasoactive therapy, testosterone for verified hypogonadism, psychosexual treatment, and penile prostheses are employed based on patient phenotype and preference. Low-intensity shockwave therapy may be advantageous in specific instances of vasculogenic disease, whereas platelet-rich plasma and stem cell methodologies remain subject to ongoing research.

Conclusion: Emergency management should be systematic, evidence-based, and focused on the patient, with prompt identification of systemic disease and the exclusion of unverified treatments.

Keywords: sexual medicine, erectile dysfunction, cardiometabolic risk, phosphodiesterase type 5 inhibitors, testosterone, penile prosthesis, shockwave therapy

Introduction

Erectile dysfunction is the ongoing inability to attain or sustain an erection adequate for satisfactory sexual performance. This definition is based on symptoms, but modern medicine sees ED as more than just a problem with the penis. This is because endothelial, cardiometabolic, endocrine, neurological, psychological, and medication-related factors often affect the same patient.¹ The cardiovascular significance is paramount: erectile dysfunction (ED) and cardiovascular disease exhibit commonalities in endothelial dysfunction, inflammation, and atherosclerosis risk, with newly manifested ED potentially preceding overt vascular incidents.² This narrative review is organized around three clinically pertinent questions: what are the causes of ED, how should it be assessed, and which therapies are endorsed by existing evidence. The sources chosen are restricted to contemporary peer-reviewed guidelines, consensus recommendations, systematic reviews, meta-analyses, and specialized reviews published predominantly in the past ten years.

Affiliation

Universitas Sumatera Utara

Correspondence:

fauzanfarhat12@gmail.com

Etiology and Pathophysiology

Vasculogenic erectile dysfunction is typically attributed to disrupted nitric oxide signaling, endothelial dysfunction, arterial insufficiency, and venous occlusion failure. Diabetes is a significant risk factor, as a meta-analysis of 145 studies indicates a substantial prevalence of erectile dysfunction in men with diabetes, particularly in those with type 2 diabetes.³ Cardiovascular disease is consistently linked to erectile dysfunction in overarching evidence, endorsing erectile dysfunction as a viable catalyst for vascular risk assessment rather than merely symptomatic treatment.⁴ Metabolic syndrome contributes through obesity, dyslipidemia, hypertension, insulin resistance, and inflammation, while insulin resistance may impair erectile physiology prior to the diagnosis of diabetes.^{5,6}

Neurogenic erectile dysfunction manifests following pelvic surgery, spinal cord injury, diabetic neuropathy, multiple sclerosis, Parkinson's disease, or trauma impacting autonomic and somatic pathways. Hypogonadism can diminish libido, nocturnal erections, and treatment response. However, testosterone therapy should be restricted to men exhibiting suitable symptoms and biochemical indicators, rather than being administered empirically.⁷ Iatrogenic causes encompass antihypertensive medications, antidepressants, antipsychotics, opioids, androgen deprivation therapy, and pelvic oncology treatments. Thus, a medication review is a crucial component of the assessment.⁸

Psychogenic and relational factors can initiate, perpetuate, or exacerbate erectile dysfunction (ED) even in the presence of organic disease. Depression and erectile dysfunction (ED) exhibit a bidirectional relationship, necessitating the assessment of mood symptoms, performance anxiety, and sexual avoidance in the evaluation of ED.⁹ Lower urinary tract symptoms often co-occur with erectile dysfunction in older men, likely due to common autonomic, vascular, and smooth muscle mechanisms. This association should inform a comprehensive urological evaluation.¹⁰ The psychosexual position statement underscores the couple's context, expectations, sexual beliefs, and relationship challenges as clinically significant factors.¹¹

Diagnostic Evaluation

Diagnosis commences with a comprehensive sexual history that encompasses onset, severity, situational variability, nocturnal or morning erections, libido, ejaculation, orgasm, pain, penile deformity, partner factors, and treatment objectives. Validated instruments like the International Index of Erectile Function can evaluate initial severity and treatment response. However, they do not supplant clinical interpretation.¹ The medical history must delineate diabetes, hypertension, dyslipidemia, tobacco use, obesity, sleep disturbances, endocrine symptoms, neurological disorders, pelvic floor surgery, recreational drug consumption, and drug exposure.¹²

The physical exam should look at the shape of the body, blood pressure, secondary sexual characteristics, gynecomastia, penile plaques, testicular size, peripheral pulses, and neurological signs. Laboratory testing is not random, it usually includes glucose or glycated hemoglobin, fasting lipids, and morning total testosterone when hypogonadism is clinically suspected.¹³ It is very important to check the cardiovascular risk in men who have just started having erectile dysfunction (ED) or who have vasculogenic ED. This is because sexual activity, exercise tolerance, and hidden cardiovascular disease should all be taken into account before treatment is increased.¹⁴

Penile duplex ultrasonography can elucidate arterial flow or venous occlusion dysfunction subsequent to pharmacological erectile induction, however, it is not requisite for all patients. A systematic review indicated that penile duplex ultrasonography frequently does not modify the management of diagnosed organic erectile dysfunction. But it might be useful in some cases, like when a young man is thought to have a vascular injury, when there are medical-legal questions, when planning surgery, or when there is a complicated nonresponse.¹⁵ Interpretation is contingent upon technique, as drug dosage, anxiety levels, timing, and local expertise affect the outcomes.¹⁶

Table 1. A comparative summary of chosen contemporary evidence regarding erectile dysfunction

Research	Base of evidence	Main point	Important clinical messages
Burnett et al. (2018) ¹	AUA Rules	Checkup and care	Employ a systematic history, targeted examination, judicious testing, and collaborative decision-making.
Salonia et al. (2025) ¹²	Update on EAU guidelines	Men's sexual health	Combine treatment for erectile dysfunction with hypogonadism, ejaculation issues, Peyronie's disease, and follow-up care.
Kohler et al. (2024). ¹⁴	IV of the Princeton Consensus	Erectile dysfunction and the risk of heart disease	New ED symptoms should lead to cardiometabolic risk stratification
Kouidrat et al. (2017) ³	145 studies in a meta-analysis	Diabetes	Men with diabetes experience a significant prevalence of erectile dysfunction and should undergo proactive screening.
Mostafaei et al. (2021) ⁴	Review of umbrellas	Heart disease	Erectile dysfunction (ED) is linked to cardiovascular risks and consequences.
Liu et al. (2018) ⁹	Meta-analysis	Sadness	Mood symptoms and erectile dysfunction exhibit a bidirectional relationship.
Corona et al. (2023) ⁵	Meta-analysis	Syndrome of metabolic syndrome	Emergency room care includes keeping an eye on blood pressure, glucose, lipids, and weight.
Nashed et al. (2021) ¹⁵	Review that is systematic	Ultrasound of the penis with duplex technology	Conduct vascular examinations exclusively for particular diagnostic or planning purposes.
Pyrgidis et al. (2021) ¹⁷	A summary of the review	Inhibitors of PDE5	PDE5 inhibitors are effective and safe for many people with erectile dysfunction.
Wang et al. (2025) ¹⁸	Suggestions from ICSM	Vacuum tool	When oral treatment isn't right or isn't enough, VED is a non-systemic option.
Yao et al. (2022) ¹⁹	A meta-analysis of 16 randomized controlled trials (RCTs)	LiSWT	Some vasculogenic erectile dysfunctions may ameliorate, although protocols differ.
Ergun et al. (2025) ²⁰	Review by Cochrane	LiSWT	The advantages may be minimal, and the evidence continues to be insufficient.
Lee et al. (2024) ⁷	Review by Cochrane	Testosterone	Do not use testosterone for erectile dysfunction unless you have confirmed hypogonadism.
Kohler et al. (2025) ²	Suggestions from ICSM	Prosthesis for the penis	Prostheses are a well-established definitive solution for refractory erectile dysfunction.
Panunzio et al. (2024) ²¹	Meta-analysis	Plasma with a lot of platelets	PRP is still in the research phase and needs more clinical trials to show its full potential.

Treatment: Established Options

The first step in treatment should be to find and fix any reversible underlying causes while also giving effective symptomatic therapy. Lifestyle interventions are clinically justified, as erectile dysfunction frequently indicates underlying vascular and metabolic disorders, a diet conducive to cardiometabolic health correlates with enhanced erectile function.²² Phosphodiesterase type 5 inhibitors remain recommended as first-line therapy for patients without contraindications to nitrate use or cardiovascular conditions that may compromise treatment safety.¹⁷ In cases of inadequate therapeutic response, several factors should be evaluated before treatment failure is established, including timing of administration, dosage adequacy, the presence of sexual stimulation, dietary interactions, optimization of comorbid conditions, testosterone status, and patient expectations.²³

Vacuum erection devices (VEDs) offer non-systemic treatment by drawing blood into the penis and sustaining an erection with a constriction ring. Modern ICSM guidelines regard VEDs as beneficial for men who favor non-pharmacological treatments, possess contraindications to oral therapy, necessitate penile rehabilitation, or exhibit an insufficient response to oral medications.¹⁸ A recent meta-analysis on refractory erectile dysfunction reinforces the viability of VEDs as a suitable adjunct or alternative following first-line treatment failure.²⁴ Intracavernosal injection and intraurethral alprostadil are effective local therapies. However, they necessitate education regarding dosing, pain management, priapism, and fibrosis.¹³

Testosterone therapy is not a prevalent intervention for erectile dysfunction. Its most significant function is in men exhibiting symptoms and persistent low morning testosterone levels, especially when

diminished libido or inadequate response to PDE5 inhibitors indicates androgen deficiency. A Cochrane review found that erectile dysfunction doesn't help most people, but a recent meta-analysis showed that it does help some men with hypogonadism. This shows that we need to be careful when diagnosing and monitoring.^{7,25}

Penile prosthesis implantation is the most well-known permanent treatment for erectile dysfunction that doesn't respond to conservative, oral, or local treatments. Current consensus recommendations stress the importance of thorough counseling regarding device type, expectations, infection risks, mechanical failure, and revision risks.² Diabetes and repeat surgery are discussed as infection-related concerns, and current evidence supports preoperative optimization rather than refusing surgery based solely on the diagnosis.^{26,27}

Restorative and Investigational Therapies

Low-intensity extracorporeal shockwave therapy has been suggested to enhance penile vascular biology in cases of vasculogenic erectile dysfunction. Prior meta-analyses indicated enhanced erectile function outcomes. However, trial protocols varied concerning devices, energy settings, treatment schedules, and endpoints.^{19,28} A recent Cochrane review was more careful and said that the benefits might not be very big and that the evidence is limited. Because of this, patients should be told about the risks and costs before treatment.²⁰

Regenerative injections ought not to be regarded as conventional treatment. Platelet-rich plasma has exhibited preliminary benefits in controlled studies. However, the evidence is constrained by small sample sizes, diverse preparation techniques, and limited follow-up duration.²¹ Stem cell therapy is biologically plausible via paracrine, angiogenic, neuroprotective, and smooth muscle-modulating effects. However, systematic and narrative reviews concur that more rigorous trials, standardized products, and long-term safety data are essential.^{29,30} Recent preclinical and early clinical studies continue to show promise. However, widespread clinical implementation is still premature.³¹

Patient

A streamlined pathway is better than having to keep raising the level of treatment. First, figure out what the dominant phenotype is and what cardiovascular, endocrine, psychological, or treatment-related problems need to be fixed right away. Second, improve lifestyle and comorbidities, and give PDE5 inhibitors when it's safe to do so. Third, check again to see if the person isn't responding because of misuse, untreated hypogonadism, severe vasculopathy, relationship problems, or unrealistic expectations. Fourth, provide VEDs, local pharmacotherapy, psychosexual treatments, or prostheses based on objectives, tolerance for invasiveness, and anticipated longevity. Psychosexual interventions are especially pertinent when anxiety, avoidance, depression, or partner-related issues hinder the efficacy of medical therapy.¹¹

Limitation and Conclusion

This review is narrative rather than systematic. Thus, it lacks duplicate screening, a formal risk-of-bias assessment, or a quantitative synthesis. The evidence base is diverse across definitions, populations, questionnaires, comorbidities, treatment protocols, and follow-up intervals, especially for shockwave and regenerative therapies. The evidence, however, supports a consistent message: erectile dysfunction (ED) should be evaluated as a men's health issue that could indicate systemic disease, the diagnosis should be organized but not too open-ended, and the treatment should be gradual, based on phenotype, and involve the patient. Optimizing risk factors, PDE5 inhibitors, VEDs, local pharmacotherapy, targeted testosterone therapy, psychosexual treatments, and penile prostheses are all well-known choices. Regenerative strategies are still being tested in clinical trials to see if they have real benefits.

References

1. Burnett AL, Nehra A, Breau RH, Culkin DJ, Faraday MM, Hakim LS, et al. Erectile Dysfunction: AUA Guideline. *J Urol*. 2018 Sep;200(3):633–41.
2. Köhler TS, Munarriz R, Parker J, Bettocchi C, Hatzichristodoulou G, Martins FE, et al. Penile prosthesis for erectile dysfunction: recommendations from the 5th International Consultation on Sexual Medicine. *Sex Med Rev*. 2025 Apr 14;13(2):144–71.
3. Kouidrat Y, Pizzol D, Cosco T, Thompson T, Carnaghi M, Bertoldo A, et al. High prevalence of erectile dysfunction in diabetes: a systematic review and meta-analysis of 145 studies. *Diabet Med*. 2017 Sep 18;34(9):1185–92.
4. Mostafaei H, Mori K, Hajebrahimi S, Abufaraj M, Karakiewicz PI, Shariat SF. Association of erectile dysfunction and

- cardiovascular disease: an umbrella review of systematic reviews and meta-analyses. *BJU Int.* 2021 Jul 9;128(1):3–11.
5. Corona DG, Vena W, Pizzocaro A, Rastrelli G, Sparano C, Sforza A, et al. Metabolic syndrome and erectile dysfunction: a systematic review and meta-analysis study. *J Endocrinol Invest.* 2023 Jul 29;46(11):2195–211.
 6. Jalali S, Zareshahi N, Behnoush AH, Azarboo A, Shirinezhad A, Hosseini SY, et al. Association of insulin resistance surrogate indices and erectile dysfunction: a systematic review and meta-analysis. *Reprod Biol Endocrinol.* 2024 Nov 19;22(1):148.
 7. Lee H, Hwang EC, Oh CK, Lee S, Yu HS, Lim JS, et al. Testosterone replacement in men with sexual dysfunction. *Cochrane Database Syst Rev.* 2024 Jan 15;2024(1).
 8. Capogrosso P, Albersen M, Burnett AL, Cakir OO, Dehó F, Morgado LA, et al. Erectile Dysfunction: Update on Clinical Management. *Eur Urol.* 2025 Oct;88(4):388–99.
 9. Liu Q, Zhang Y, Wang J, Li S, Cheng Y, Guo J, et al. Erectile Dysfunction and Depression: A Systematic Review and Meta-Analysis. *J Sex Med.* 2018 Aug 1;15(8):1073–82.
 10. De Nunzio C, Roehrborn CG, Andersson KE, McVary KT. Erectile Dysfunction and Lower Urinary Tract Symptoms. *Eur Urol Focus.* 2017 Oct;3(4–5):352–63.
 11. Dewitte M, Bettocchi C, Carvalho J, Corona G, Flink I, Limoncin E, et al. A Psychosocial Approach to Erectile Dysfunction: Position Statements from the European Society of Sexual Medicine (ESSM). *Sex Med.* 2021 Dec 1;9(6):100434–100434.
 12. Salonia A, Capogrosso P, Boeri L, Cocci A, Corona G, Dinkelmann-Smit M, et al. European Association of Urology Guidelines on Male Sexual and Reproductive Health: 2025 Update on Male Hypogonadism, Erectile Dysfunction, Premature Ejaculation, and Peyronie's Disease. *Eur Urol.* 2025 Jul;88(1):76–102.
 13. Stern N, Bajic P, Campbell J, Capogrosso P, Domes T, Miranda EP, et al. Evolving medical management of erectile dysfunction: recommendations from the Fifth International Consultation on Sexual Medicine (ICSM 2024). *Sex Med Rev.* 2025 Oct 4;13(4):513–37.
 14. Köhler TS, Kloner RA, Rosen RC, Burnett AL, Blaha MJ, Ganz P, et al. The Princeton IV Consensus Recommendations for the Management of Erectile Dysfunction and Cardiovascular Disease. *Mayo Clin Proc.* 2024 Sep;99(9):1500–17.
 15. Nashed A, Lokeshwar SD, Frech F, Mann U, Patel P. The Efficacy of Penile Duplex Ultrasound in Erectile Dysfunction Management Decision-Making: A Systematic Review. *Sex Med Rev.* 2021 Jul;9(3):472–7.
 16. Elgendi K, Zulia N, Beilan J. A Review on Penile Doppler and Ultrasonography for Erectile Dysfunction. *Curr Urol Rep.* 2023 Feb 22;24(2):69–74.
 17. Pyrgidis N, Mykoniatis I, Haidich AB, Tirta M, Talimtzis P, Kalyvianakis D, et al. Effect of phosphodiesterase-type 5 inhibitors on erectile function: an overview of systematic reviews and meta-analyses. *BMJ Open.* 2021 Aug;11(8):e047396.
 18. Wang R, Martins FE, Ralph D, Hatzichristodoulou G, Osmonov D, Parker J, et al. Vacuum erectile devices for erectile dysfunction: recommendations from the 5th international consultation on sexual medicine. *Sex Med Rev.* 2025 Apr 14;13(2):172–83.
 19. Yao H, Wang X, Liu H, Sun F, Tang G, Bao X, et al. Systematic Review and Meta-Analysis of 16 Randomized Controlled Trials of Clinical Outcomes of Low-Intensity Extracorporeal Shock Wave Therapy in Treating Erectile Dysfunction. *Am J Mens Health.* 2022 Mar 23;16(2).
 20. Ergun O, Kim K, Kim MH, Hwang EC, Blair Y, Gudeloglu A, et al. Low-intensity shockwave therapy for erectile dysfunction. *Cochrane Database Syst Rev.* 2025 Jul 14;2025(7).
 21. Panunzio A, Labate C, Zacheo F, Orlando R, Rizzo FL, Porcaro AB, et al. Platelet-rich plasma intracavernosal injections for the treatment of primary organic erectile dysfunction: a systematic review and meta-analysis of contemporary controlled studies. *Int J Impot Res.* 2024 Sep 22;36(6):562–71.
 22. Yang B, Wei C, Zhang YC, Ma DL, Bai J, Liu Z, et al. Association between improved erectile function and dietary patterns: a systematic review and meta-analysis. *Asian J Androl.* 2025 Mar;27(2):239–44.
 23. Scaglione F, Donde S, Hassan TA, Jannini EA. Phosphodiesterase Type 5 Inhibitors for the Treatment of Erectile Dysfunction: Pharmacology and Clinical Impact of the Sildenafil Citrate Orodispersible Tablet Formulation. *Clin Ther.* 2017 Feb;39(2):370–7.
 24. Zhang F, Luo Z, Xue Q, Guo X, Zhang W, Xiong Y, et al. Efficacy of vacuum erectile device in refractory erectile dysfunction: a systematic review and meta-analysis. *Int J Impot Res.* 2026 Feb 20;38(2):76–85.
 25. Xu Z, Chen X, Zhou H, Ren C, Wang Q, Pan Y, et al. An updated systematic review and meta-analysis of the effects of testosterone replacement therapy on erectile function and prostate. *Front Endocrinol (Lausanne).* 2024 Jan 26;15.
 26. Menshchikov K, Menshchikov M, Yurasov D, Artamonov A. Risk factors for penile prosthesis infection: An umbrella review and meta-analysis. *Arab J Urol.* 2024 Apr 2;22(2):96–101.
 27. Gon LM, de Campos CCC, Voris BRI, Passeri LA, Fregonesi A, Riccetto CLZ. A systematic review of penile prosthesis infection and meta-analysis of diabetes mellitus role. *BMC Urol.* 2021 Dec 10;21(1):35.
 28. Man L, Li G. Low-intensity Extracorporeal Shock Wave Therapy for Erectile Dysfunction: A Systematic Review and Meta-analysis. *Urology.* 2018 Sep;119:97–103.
 29. Wang B, Gao W, Zheng MY, Lin G, Lue TF. Recent advances in stem cell therapy for erectile dysfunction: a narrative review. *Expert Opin Biol Ther.* 2023 Jun 3;23(6):565–73.
 30. Furtado TP, Saffati G, Furtado MH, Khera M. Stem cell therapy for erectile dysfunction: a systematic review. *Sex Med Rev.* 2023 Dec 23;12(1):87–93.
 31. Fu X, Sheikholeslami A, Zhanbyrbekuly U, Davoodi Asl F, Mussin NM, Fazaeli H, et al. Advances in stem cell therapy for erectile dysfunction: preclinical evidence and emerging therapeutic approaches. *Front Med.* 2025 Apr 2;12.