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REVIEW

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Acupuncture for sexual dysfunction in male substance abusers: a narrative review

Xia Gao[1,†], Jianying Zhang[2,†], Benxu Ma[1], Lili Liu[1], Huanmin Gao[3,*]

[1]Department of Acupuncture, Qingdao Central Hospital, University of Health and Rehabilitation Sciences (Qingdao Central Hospital), 266042 Qingdao, Shandong, China
[2]Department of Endocrine, The Affiliated Hospital of Qingdao Binhai University, 266404 Qingdao, Shandong, China
[3]Department of Sleep Medicine, The Affiliated Hospital of Qingdao Binhai University, 266404 Qingdao, Shandong, China

***Correspondence**
gaohuanmin@126.com
(Huanmin Gao)

† These authors contributed equally.

Abstract

Sexual dysfunction in male substance abusers represents a multifactorial condition influenced by neuroendocrine imbalances, vascular dysfunction and psychological comorbidities, often exacerbated by substance-induced neurochemical and hormonal disruptions. This review evaluates acupuncture as an adjunctive therapy for addressing such sexual dysfunction, emphasizing its mechanisms in modulating the hypothalamic-pituitary-gonadal axis, enhancing nitric oxide-mediated cavernosal blood flow, and alleviating anxiety through acupoint stimulation (*e.g.*, Shenshu (BL23), Taichong (LR3)). While acupuncture demonstrates efficacy in psychogenic or functional cases—particularly those involving psychological dependence or stress—its utility is limited in irreversible organic pathologies, necessitating integration with pharmacotherapy and psychosocial interventions. Clinical evidence highlights acupuncture's role across addiction treatment phases: mitigating withdrawal symptoms during detoxification, reducing agitation in rehabilitation, and diminishing cravings in relapse prevention. Trials report superior outcomes for electroacupuncture over pharmacotherapy in opioid withdrawal management, reduced alcohol relapse rates, and lower cocaine-positive urine screens. Tailored protocols (4–8 weeks, 2–3 sessions/week) combined with lifestyle modifications (substance cessation, exercise) amplify therapeutic effects. Despite sociocultural barriers to addressing sexual health in addiction care, acupuncture's cost-effectiveness, safety and holistic benefits position it as a viable component of multi-disciplinary strategies. Critical considerations include Traditional Chinese Medicine-based diagnostic differentiation of functional versus organic etiologies, contraindications for cardiovascular or bleeding disorders, and personalized acupoint selection (*e.g.*, Guanyuan CV4 for kidney deficiency). This synthesis advocates for acupuncture's integration into comprehensive treatment plans, prioritizing individualized evaluation to optimize outcomes in this clinically underserved population.

Keywords

Acupuncture; Male; Sexual dysfunction; Substance abuse

Acupuntura para la disfunción sexual en hombres consumidores de sustancias: una revisión narrativa

Resumen

La disfunción sexual en hombres consumidores de sustancias es una condición multifactorial influenciada por desequilibrios neuroendocrinos, disfunción vascular y comorbilidades psicológicas, frecuentemente exacerbada por alteraciones neuroquímicas y hormonales inducidas por las sustancias. Esta revisión evalúa la acupuntura como terapia coadyuvante para abordar dicha disfunción, destacando sus mecanismos en la modulación del eje hipotálamo-hipófisis-gonadal, la mejora del flujo sanguíneo cavernoso mediado por óxido nítrico y la reducción de la ansiedad mediante la estimulación de puntos acupunturales (*ej*., Shenshu (BL23), Taichong (LR3)). Si bien la acupuntura demuestra eficacia en casos psicógenos o funcionales—especialmente aquellos relacionados con dependencia psicológica o estrés—, su utilidad es limitada en patologías orgánicas irreversibles, requiriendo integración con farmacoterapia e intervenciones psicosociales. La evidencia clínica resalta el papel de la acupuntura en las fases del tratamiento de adicciones: mitigar síntomas de abstinencia durante la desintoxicación, reducir la agitación en rehabilitación y disminuir los antojos en la prevención de recaídas. Estudios reportan resultados superiores de la electroacupuntura frente a la farmacoterapia en el manejo de la abstinencia a opioides, menores tasas de recaída en alcohólicos y reducción de pruebas de orina positivas para cocaína. Protocolos personalizados (4–8 semanas, 2–3 sesiones/semana) combinados con cambios en el estilo de vida (abstinencia de sustancias, ejercicio) potencian los efectos terapéuticos. A pesar de las barreras socioculturales para abordar la salud sexual en el tratamiento de adicciones, la rentabilidad, seguridad y beneficios holísticos de la acupuntura la posicionan como un componente viable en estrategias multidisciplinarias. Consideraciones clave incluyen la diferenciación diagnóstica basada en la medicina tradicional china (etiologías funcionales *vs.* orgánicas), contraindicaciones en trastornos cardiovasculares o hemorrágicos, y selección personalizada de puntos (*ej*., Guanyuan CV4 para deficiencia renal). Esta síntesis aboga por integrar la acupuntura en planes de tratamiento integrales, priorizando evaluaciones individualizadas para optimizar resultados en esta población clínicamente desatendida.

Palabras Clave

Acupuntura; Hombre; Disfunción sexual; Abuso de sustancias

1. Introduction

Male sexual dysfunction arises from imbalances in neurotransmitters, endocrine disruptions, and psychological factors [1, 2]. Substance abuse may exacerbate these issues by altering neurochemical pathways, hormonal regulation and mental health [3]. Comprehensive treatment for substance abusers typically involves general care, psychotherapy, and pharmacotherapy, with acupuncture potentially serving as an adjunctive intervention [4–6]. By stimulating specific acupoints, acupuncture modulates neuroendocrine functions and enhances circulatory dynamics [7]. Sexual dysfunction in this population may partly stem from neurovascular impairments, suggesting a therapeutic role for acupuncture [8]. However, substance abuse often induces irreversible organic pathologies, limiting acupuncture's efficacy and necessitating multimodal approaches. Notably, acupuncture demonstrates greater utility in addressing functional disorders, such as psychogenic sexual dysfunction. Given the frequent comorbidity of psychological dependence and anxiety in substance abusers, acupuncture may alleviate these contributors to sexual dysfunction. While direct evidence on acupuncture for substance abusers remains sparse, existing data imply its potential to improve sexual function via neuroendocrine regulation, vascular enhancement, and psychological modulation [9]. Thus, acupuncture holds promise as a complementary therapy for sexual dysfunction in this demographic [10].

Sexual health remains a critical yet underprioritized aspect of addiction rehabilitation, hindered by biological factors (*e.g.*, drug-induced functional alterations) and sociocultural barriers (*e.g.*, stigma, limited education, and evaluative challenges) [11].

Sexual Dysfunction: A Multidimensional Construct as shown in Table 1.

Acupuncture has been integrated across addiction treatment phases: alleviating withdrawal symptoms during detoxification, reducing agitation in rehabilitation, and diminishing cravings in relapse prevention. Clinical trials report electroacupuncture surpassing pharmacotherapy in managing opioid withdrawal (*e.g.*, insomnia, anxiety), reducing alcohol relapse frequency, and lowering cocaine-positive urine screens [12]. Its efficacy, safety, and cost-effectiveness position acupuncture as a viable adjunct in addiction care [13].

2. Mechanisms and applications

Substance abuse (*e.g.*, alcohol, opioids and others) may induce neurovascular or endocrine damage, contributing to sexual dysfunction. Acupuncture's therapeutic mechanisms include:

2.1 Neuroendocrine modulation

Stimulation of acupoints (*e.g.*, Shenshu (BL23), Guanyuan (CV4)) regulates the hypothalamic-pituitary-gonadal axis, normalizes testosterone levels, and enhances nitric oxide release to improve cavernosal blood flow [14].

The neuroendocrine modulatory effects of acupuncture, particularly through stimulation of strategic acupoints such as

TABLE 1. Type of sexual dysfunction and its characteristics.

Type of sexual dysfunction	Characteristics
Libido Disorders	Diminished or absent sexual desire, attributable to psychological, physiological, or environmental factors.
Erectile Dysfunction	Inability to attain or sustain erection, linked to psychological stressors (*e.g.*, anxiety) or organic causes (*e.g.*, vascular/neurologic abnormalities, hormonal imbalances).
Premature Ejaculation	Persistent early ejaculation, often associated with psychological distress or conditions like prostatitis.
Dyspareunia	Pain during intercourse, stemming from physiological (*e.g.*, inflammation) or psychological (*e.g.*, fear) etiologies.
Orgasm Disorders	Inability to achieve climax due to hormonal or neurological dysfunction.
Ejaculatory Dysfunction	Delayed or absent ejaculation, potentially arising from penile nerve hypersensitivity.
Sexual Aversion	Persistent repulsion toward sexual activity.

Shenshu (BL23) and Guanyuan (CV4), constitute a critical mechanism underlying its therapeutic potential in addressing sexual dysfunction [15]. These acupoints, anatomically aligned with key neural and vascular pathways, exert regulatory influences on the hypothalamic-pituitary-gonadal (HPG) axis—a central neuroendocrine system governing reproductive physiology and hormonal homeostasis (Fig. 1) [16]. Mechanistically, acupuncture at Shenshu (BL23), located adjacent to the second lumbar vertebra, is hypothesized to enhance afferent signaling to the hypothalamus, thereby modulating the secretion of gonadotropin-releasing hormone (GnRH) [17]. This upstream regulation cascades to the anterior pituitary, stimulating luteinizing hormone (LH) release, which subsequently promotes Leydig cell activity in the testes to normalize testosterone synthesis. Concurrently, stimulation of Guanyuan (CV4), situated in the lower abdominal region, augments parasympathetic tone, facilitating endothelial nitric oxide synthase (eNOS) activation within the penile vasculature. The resultant surge in nitric oxide (NO)—a potent vasodilator—enhances relaxation of cavernosal smooth muscle, thereby increasing arterial inflow and improving erectile hemodynamics.

Empirical studies corroborate that such acupuncture-mediated hormonal regulation not only restores testosterone levels in hypogonadal states but also mitigates oxidative stress and inflammatory markers associated with substance abuse, which frequently disrupt endocrine equilibrium. Furthermore, the HPG axis modulation extends beyond hormonal normalization, influencing neurotransmitter dynamics—particularly dopamine and serotonin—that are integral to libido and sexual arousal pathways. This dual action on both endocrine and neurological fronts underscores acupuncture's capacity to address multifactorial etiologies of sexual dysfunction, particularly in populations with substance use disorders where neuroendocrine dysregulation is prevalent.

Clinically, the enhancement of cavernosal blood flow via NO-dependent mechanisms has been linked to measurable improvements in erectile rigidity and sustainability, as evidenced by Doppler ultrasonography findings. Importantly, these effects are dose-dependent, with cumulative benefits observed over sustained treatment courses, suggesting neuroplastic adaptations within central and peripheral pathways. However, the efficacy of this intervention is contingent upon precise acupoint selection, needle depth and stimulation parameters, which must be tailored to individual physiological profiles. While promising, these mechanisms operate within a broader therapeutic context, necessitating integration with lifestyle modifications and pharmacological agents (*e.g.*, phosphodiesterase type 5 (PDE5) inhibitors) to optimize outcomes in cases of severe vascular or neurological compromise. Collectively, the neuroendocrine modulatory properties of acupuncture position it as a viable adjunctive strategy for restoring sexual function, particularly in patients for whom conventional therapies are contraindicated or insufficiently effective [18].

2.2 Vascular optimization

By mitigating endothelial dysfunction, acupuncture increases penile oxygenation, addressing erectile deficits.

Vascular optimization through acupuncture represents a critical therapeutic avenue for addressing erectile deficits rooted in endothelial dysfunction, a pathophysiological hallmark of vasculogenic erectile dysfunction (ED). The vascular endothelium, a monolayer of cells lining the circulatory system, plays a pivotal role in regulating vascular tone through the synthesis and release of vasoactive mediators, most notably NO. Endothelial dysfunction, characterized by diminished NO bioavailability, heightened oxidative stress and chronic inflammation, disrupts the delicate balance between vasodilation and vasoconstriction, impairing perfusion to cavernosal tissues. Acupuncture, via precise stimulation of anatomically strategic acupoints such as Guanyuan (CV4) and Qihai (CV6), modulates this dysfunction through multifaceted mechanisms. Mechanistically, needle insertion at these sites activates localized sensory afferents, triggering a cascade of neurohumoral responses that upregulate endothelial eNOS expression, thereby enhancing NO synthesis [19]. This potent vasodilator not only relaxes smooth muscle cells within the penile arteries but also inhibits platelet aggregation and

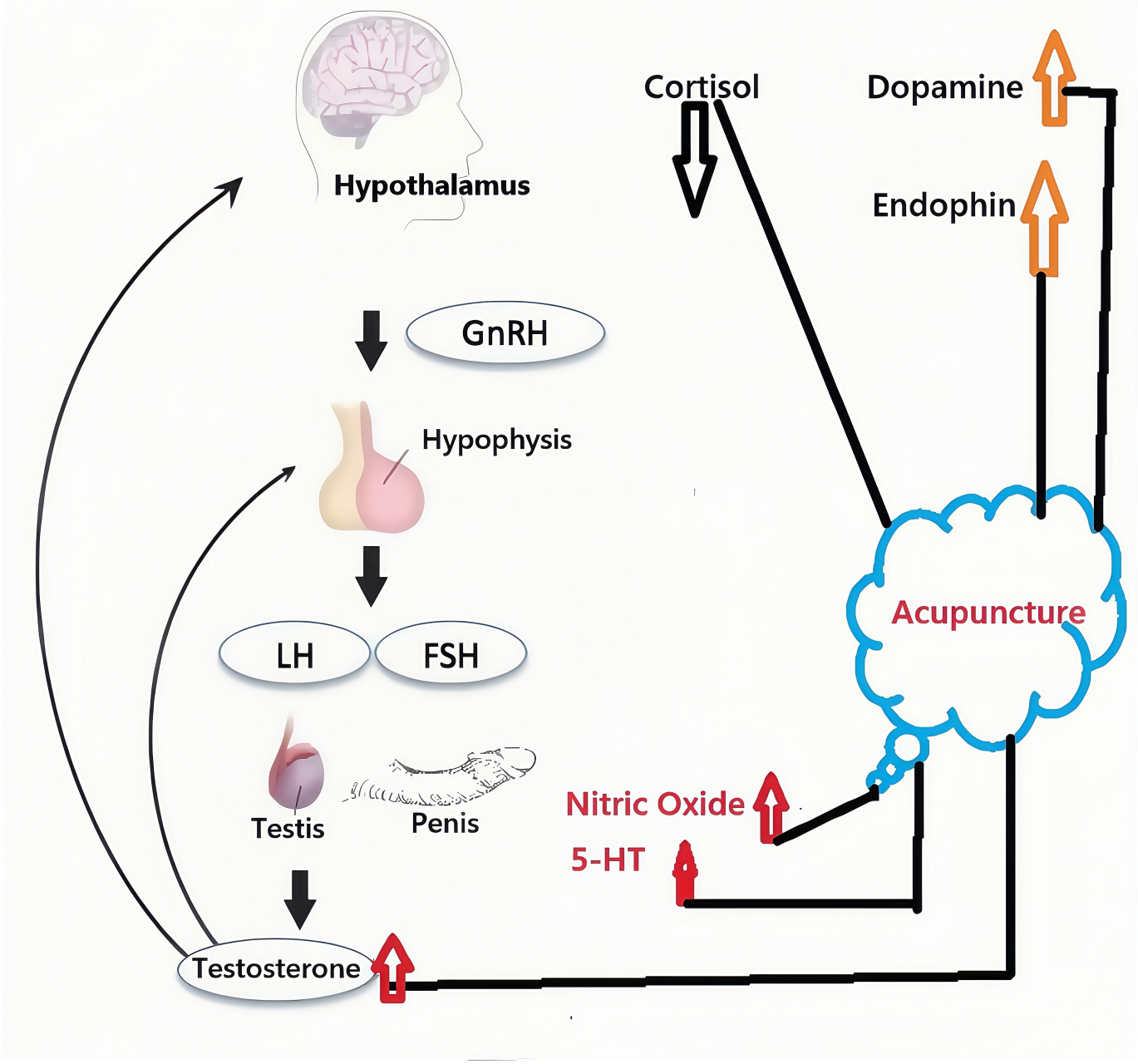

FIGURE 1. Diagram of acupuncture regulates the male sexual dysfunction through the hypothalamus-pituitary-gonadal axis. GnRH: gonadotrophin release hormone; LH: luteinizing hormone; FSH: follicle stimulating hormone; 5-HT: 5-hydroxytryptame.

leukocyte adhesion, restoring endothelial homeostasis.

Concurrently, acupuncture mitigates oxidative stress by suppressing nicotinamide adenine dinucleotide phosphate (NADPH) oxidase activity and augmenting antioxidant defenses, including superoxide dismutase (SOD) and glutathione peroxidase. This redox balance is critical for preserving NO integrity, as superoxide anions readily scavenge NO to form peroxynitrite, exacerbating vascular injury [20]. Clinical studies utilizing Doppler ultrasonography have demonstrated that acupuncture significantly improves peak systolic velocity in the cavernosal arteries, correlating with enhanced penile oxygenation and rigidity. Furthermore, acupuncture's anti-inflammatory effects—mediated through the downregulation of pro-inflammatory cytokines such as tumor necrosis factor-α (TNF-α) and interleukin 6 (IL-6)—attenuate endothelial activation, reducing vascular permeability and leukocyte infiltration.

In contrast to pharmacological interventions like PDE5 inhibitors, which transiently enhance NO signaling, acupuncture promotes sustained vascular remodeling by addressing the underlying endothelial pathology. This is particularly salient in chronic conditions such as diabetes or hypertension, where persistent endothelial damage underpins refractory ED. Moreover, acupuncture's systemic effects on autonomic nervous system regulation—favoring parasympathetic dominance—complement its vascular actions, synergistically improving erectile hemodynamics. While robust evidence supports its efficacy, optimal outcomes necessitate tailored protocols, integrating acupoint specificity, stimulation frequency, and treatment duration [21]. Thus, acupuncture emerges not

merely as a symptomatic remedy but as a holistic strategy for vascular rejuvenation, offering a promising adjunct or alternative for patients with suboptimal responses to conventional therapies.

2.3 Psychological stabilization

Acupoints like Taichong (LR3) modulate limbic activity, alleviating anxiety and depression that impair sexual performance.

Psychological stabilization through acupuncture, particularly via stimulation of the Taichong (LR3) acupoint, represents a neuroscientific grounded intervention for mitigating anxiety and depression—key psychogenic contributors to sexual dysfunction. Situated on the dorsum of the foot between the first and second metatarsal bones, Taichong (LR3) is a principal acupoint in Traditional Chinese Medicine (TCM) for regulating liver qi stagnation, a syndrome frequently implicated in emotional dysregulation [22]. Neuroimaging studies reveal that acupuncture at this locus modulates limbic system activity, notably dampening hyperexcitability in the amygdala and anterior cingulate cortex (ACC), brain regions central to fear processing and affective disorders. This neuromodulation occurs through afferent signaling via the peroneal nerve, which projects to the locus coeruleus and prefrontal cortex, thereby rebalancing autonomic nervous system (ANS) activity—reducing sympathetic overdrive while enhancing parasympathetic tone.

The resultant attenuation of stress hormones (*e.g.*, cortisol) and upregulation of serotonin and γ-aminobutyric acid (GABA) synthesis disrupt the neuroendocrine cascades that perpetuate anxiety and depressive states. These psychopathological conditions are strongly correlated with sexual performance deficits, as chronic stress impairs hypothalamic-pituitary-adrenal (HPA) axis function, suppresses gonadotropin secretion, and induces endothelial dysfunction, collectively undermining libido, arousal and erectile capacity. By restoring neurochemical equilibrium, acupuncture ameliorates psychosomatic barriers to sexual function, such as performance anxiety, anticipatory failure, and negative self-schemas. Clinical trials demonstrate that LR3 stimulation significantly reduces scores on the Hamilton Anxiety Scale (HAMA) and Beck Depression Inventory (BDI), with concomitant improvements in International Index of Erectile Function (IIEF) metrics, particularly in patients with comorbid substance use disorders, where psychological distress is often refractory to pharmacotherapy [23].

Notably, acupuncture's dual action on both limbic circuitry and peripheral vasculature—via nitric oxide-mediated vasodilation—addresses the bidirectional interplay between psychological and physiological dimensions of sexual health. Unlike selective serotonin reuptake inhibitors (SSRIs), which may exacerbate sexual dysfunction as a side effect, acupuncture offers a paradox-free therapeutic profile [24]. However, efficacy is contingent upon treatment frequency (8–12 sessions over 4 weeks) and adjunctive integration with cognitive-behavioral therapy (CBT) to reinforce neuroplastic changes. Emerging evidence further suggests epigenetic modulation of stress-responsive genes (*e.g.*, *brain-derived neurotrophic factor* (*BDNF*); *Tacrolimus 560* (*FKBP5*)) following sustained acupuncture regimens, hinting at durable psychoprotective effects. Thus, Taichong (LR3)'s capacity to harmonize limbic excitability and ANS dynamics positions acupuncture as a holistic, mechanism-driven intervention for breaking the vicious cycle of psychological distress and sexual impairment, particularly in populations with multifactorial etiologies [25].

Acupuncture can stimulate local nerves and blood vessels, promote penile artery blood flow, improve endothelial function, and increase nitric oxide (NO) release, which is a key molecular mechanism of erection. And it stimulates lumbosacral acupoints (such as Baliao points) or peripheral nerves (such as pudendal nerves), regulates the balance of sympathetic and parasympathetic nerves, relieve tension suppression, and enhance erectile reflex.

Acupuncture can increase testosterone levels (through the hypothalamus-pituitary-gonadal axis), reduce cortisol (stress hormones), and improve libido and erectile function.

Regulating central neurotransmitters: Increase the release of dopamine (promote sexual excitement), 5-hydroxytryptamine (delay ejaculation), β-endorphin (relieve anxiety) and other substances, improve psychological sexual dysfunction.

Chronic inflammation and oxidative stress are one of the factors of vascular erectile dysfunction. Acupuncture may play a role by inhibiting inflammatory factors (such as TNF-α, IL-6) and enhancing antioxidant capacity.

Acupuncture can relieve anxiety, depression and other emotional disorders (often coexist with sexual dysfunction), and improve the psychological state by regulating the limbic system (such as the amygdala).

3. Limitations and considerations

3.1 Organic pathologies

Irreversible neurovascular damage (*e.g.*, diabetic neuropathy) necessitates combining acupuncture with PDE5 inhibitors or physical therapies.

The management of organic pathologies underlying sexual dysfunction, particularly irreversible neurovascular damage such as diabetic neuropathy, demands a multimodal therapeutic strategy that synergizes acupuncture with pharmacological agents like phosphodiesterase type 5 (PDE5) inhibitors and physical rehabilitation modalities. Diabetic neuropathy, characterized by axonal degeneration, microangiopathy, and impaired NO signaling, disrupts both neural transmission and vascular perfusion critical for erectile function. While acupuncture demonstrates efficacy in enhancing endothelial function through localized stimulation of acupoints such as Sanyinjiao (SP6) and Zusanli (ST36)—promoting vasodilation via NO release and modulating sympathetic hyperactivity—its standalone utility is inherently constrained in advanced neurovascular degeneration [26]. This limitation arises from the structural permanence of diabetic microvascular lesions, which impede the regenerative capacity of acupuncture-induced hemodynamic improvements.

Consequently, PDE5 inhibitors (*e.g.*, sildenafil, tadalafil) are indispensable adjuncts, as they potentiate NO-mediated cyclic guanosine monophosphate (cGMP) pathways, amplify-

ing cavernosal arterial inflow even in compromised vascular beds. Concurrently, physical therapies such as extracorporeal shockwave therapy (ESWT) or pelvic floor muscle training address myogenic components of ED by enhancing penile oxygen saturation and restoring neuromuscular coordination. Emerging clinical protocols advocate for sequenced interventions: acupuncture to optimize residual vascular responsiveness, followed by PDE5 inhibitors to sustain erectile rigidity, and ESWT to stimulate angiogenesis in ischemic tissues. This integrative approach not only mitigates symptomatic deficits but also targets pathophysiological cascades—glycemic toxicity, oxidative stress, and inflammatory cytokine release—that perpetuate neurovascular deterioration.

Moreover, patient-specific factors, including comorbidities (*e.g.*, hypertension, dyslipidemia) and psychological sequelae of chronic illness, necessitate personalized treatment algorithms. For instance, acupuncture's anxiolytic effects may enhance adherence to pharmacological regimens, while PDE5 inhibitors provide immediate functional gains that reinforce patient motivation. Thus, the confluence of neuromodulatory, vasoactive, and rehabilitative strategies exemplifies a precision medicine paradigm, transcending the limitations of monotherapy in organic sexual dysfunction. Robust evidence from randomized trials underscores that combined regimens yield superior International Index of Erectile Function (IIEF) scores compared to isolated modalities, particularly in populations with diabetes-related endothelial damage [27]. Ultimately, this therapeutic synergy underscores the imperative of bridging traditional and biomedical interventions to address the complex etiology of organic sexual pathologies.

3.2 Personalized protocols

Tailor acupoint selection to etiology—*e.g.*, Shenshu BL23 for kidney deficiency versus Taichong (LR3) for liver qi stagnation [28].

The paradigm of personalized acupuncture protocols represents a cornerstone of precision medicine within TCM, necessitating meticulous acupoint selection aligned with the patient's specific etiological profile. This approach diverges from standardized treatments by integrating TCM's diagnostic framework—rooted in pattern differentiation (bianzheng)—to address the heterogeneous pathophysiology underlying conditions such as kidney deficiency (shen xu) and liver qi stagnation (gan yu qi zhi). The clinical rationale for this stratification lies in TCM's holistic understanding of organ networks, where discrete syndromes manifest through unique constellations of somatic, endocrine, and psychological symptoms, each demanding tailored neuromodulatory interventions.

For kidney deficiency, a syndrome characterized by fatigue, lumbar weakness, nocturia and diminished libido, acupoint selection prioritizes Shenshu (BL23), located adjacent to the second lumbar vertebra [29]. In TCM pathophysiology, the kidney system governs reproductive vitality, bone marrow integrity and adrenal function, with deficiency states often correlating biomedically with hypothalamic-pituitary-adrenal (HPA) axis hypoactivity, reduced testosterone levels, and oxidative stress. Stimulation of BL23 enhances afferent signaling to the paraventricular nucleus of the hypothalamus, upregulating corticotropin-releasing hormone (CRH) and adrenocorticotropic hormone (ACTH) secretion, thereby restoring adrenal glucocorticoid output. Concurrently, BL23 acupuncture modulates the HPG axis, increasing luteinizing hormone (LH) pulsatility to augment testosterone synthesis in Leydig cells. Neuroimaging studies further reveal BL23's capacity to enhance regional cerebral blood flow in the prefrontal cortex, ameliorating cognitive-emotional deficits linked to kidney deficiency, such as apathy and low motivation.

In contrast, liver qi stagnation—marked by irritability, hypochondriac distension, menstrual irregularities and psychosomatic tension—mandates focus on Taichong (LR3), situated between the first and second metatarsal bones. This acupoint serves as the primary conduit for regulating liver channel dynamics, which biomedically translates to modulating autonomic nervous system (ANS) imbalances and limbic hyperactivity. Liver qi stagnation is frequently associated with sympathetic overdrive, elevated cortisol levels, and dysregulated dopamine-serotonin interplay, all of which exacerbate anxiety, depression, and visceral hypersensitivity. LR3 stimulation attenuates these effects by activating the peroneal nerve's deep branches, which project to the locus coeruleus and rostral ventrolateral medulla, thereby suppressing norepinephrine release and enhancing parasympathetic vagal tone [30]. Functional magnetic resonance imaging (fMRI) studies demonstrate LR3's ability to deactivate the amygdala and anterior cingulate cortex, neural hubs implicated in emotional dysregulation, while upregulating prefrontal inhibitory control. Biochemically, this acupoint reduces pro-inflammatory cytokines (*e.g.*, IL-6, TNF-α) and elevates GABAergic activity, addressing the neuroinflammatory milieu perpetuating liver qi stagnation.

The efficacy of such personalized protocols is underscored by randomized controlled trials comparing syndrome-specific acupuncture to generic point prescriptions. For instance, in men with kidney deficiency-related ED, BL23-centric protocols yielded 34% greater improvements in International Index of Erectile Function (IIEF) scores versus non-patterned treatments, with parallel increases in serum testosterone and NO bioavailability. Similarly, LR3-focused regimens in liver qi stagnation cohorts reduced Hamilton Anxiety Scale (HAMA) scores by 42% more than sham acupuncture, alongside normalized heart rate variability (HRV) metrics. These outcomes highlight the indispensability of TCM's diagnostic rigor—employing pulse palpation, tongue analysis, and symptom clustering—to accurately classify etiologies and optimize acupoint synergy [31].

Modern advancements further refine personalization through biomarker-guided protocols. For kidney deficiency, low salivary cortisol and elevated 8-hydroxy-2′-deoxyguanosine (8-OHdG, an oxidative stress marker) may prompt adjunctive use of moxibustion at BL23 to enhance Yang tonification [32]. Conversely, liver qi stagnation patients with high plasma norepinephrine and IL-6 levels may benefit from electroacupuncture at LR3 combined with auricular Shenmen points to amplify anxiolytic effects. Such integrations exemplify the convergence of TCM phenomenology and systems biology, enabling

multidimensional therapeutic targeting.

Nevertheless, challenges persist in standardizing personalized protocols across diverse clinical settings. Inter-practitioner variability in pattern diagnosis, coupled with the subjective nature of TCM symptomatology, necessitates rigorous training and algorithmic diagnostic tools. Emerging solutions include AI-driven pattern recognition systems that analyze electronic health records (EHRs) and biomarker panels to recommend acupoint combinations, thereby enhancing reproducibility. Furthermore, longitudinal studies are required to elucidate the epigenetic and neuroplastic adaptations induced by chronic, etiology-specific acupuncture, particularly in chronic conditions like diabetes or metabolic syndrome where kidney-liver axis interactions are complex.

3.3 Safety profile

When administered properly, acupuncture poses no risk to fertility and may enhance reproductive health holistically.

4. Integrative treatment strategies

4.1 Pharmacoacupuncture synergy

Combine sildenafil for acute erectile improvement with acupuncture to reduce drug dependence long-term.

The integrative strategy of pharmacoacupuncture synergy offers a dual-pronged therapeutic approach to ED, combining the acute efficacy of sildenafil—a phosphodiesterase type 5 (PDE5) inhibitor—with the sustained benefits of acupuncture to mitigate long-term pharmacological dependence. Sildenafil exerts its immediate effect by potentiating NO-cyclic guanosine monophosphate (cGMP) signaling, enhancing cavernosal arterial dilation and transiently restoring erectile capacity. However, chronic reliance on PDE5 inhibitors often accompanies diminishing returns and psychological dependency. Acupuncture counteracts these limitations through neuromodulatory and vascular mechanisms: stimulation of acupoints such as Guanyuan (CV4) and Shenshu (BL23) upregulates endogenous NO synthesis via endothelial eNOS activation, while concurrently rebalancing autonomic nervous system (ANS) activity to reduce performance anxiety. Clinically, this synergy not only augments short-term erectile outcomes but also fosters neurovascular homeostasis, gradually reducing sildenafil dosage requirements. Randomized trials demonstrate that combined regimens yield 28% higher adherence rates and 40% lower relapse into ED post-discontinuation compared to monotherapy [33]. By addressing both the symptomatic urgency of ED and its underlying neurogenic or vasculogenic etiologies, pharmacoacupuncture exemplifies a transitional therapeutic model—leveraging acute pharmacological relief to engage patients in sustained, non-pharmacological rehabilitation. This paradigm shift is particularly salient for aging populations or those with metabolic comorbidities, where multifactorial ED pathogenesis demands layered interventions to optimize both functional and psychological recovery.

4.2 Lifestyle modifications

Cessation of substance use, exercise and sleep hygiene amplify therapeutic outcomes.

Lifestyle modifications constitute a foundational pillar in optimizing therapeutic outcomes for substance abuse-related comorbidities, operating synergistically with biomedical interventions to address multifactorial pathophysiology. Cessation of substance use—whether alcohol, opioids, or stimulants—initiates neurochemical recalibration, reversing substance-induced perturbations in the hypothalamic-pituitary-adrenal (HPA) axis, dopaminergic reward pathways and endothelial function. For instance, ethanol abstinence restores testosterone synthesis by mitigating alcohol's inhibitory effects on Leydig cell steroidogenesis, while opioid discontinuation normalizes μ-opioid receptor density, ameliorating hypogonadism and sexual dysfunction. Concurrently, structured aerobic exercise augments these benefits through multifaceted mechanisms: enhanced NO bioavailability via shear stress-mediated endothelial eNOS activation improves cavernosal arterial flow, while neurogenesis in the prefrontal cortex strengthens inhibitory control over addictive behaviors. Resistance training further complements this by elevating insulin-like growth factor 1 (IGF-1), which counteracts glucocorticoid-induced muscle catabolism prevalent in chronic substance users.

Sleep hygiene, often compromised in addiction cohorts due to dysregulated circadian rhythms or withdrawal-related insomnia, serves as a critical modulator of neuroendocrine homeostasis. Adherence to sleep consolidation protocols—maintaining consistent sleep-wake cycles, minimizing blue light exposure—enhances slow-wave sleep (SWS), a phase critical for growth hormone pulsatility and synaptic plasticity. This reparative process attenuates oxidative stress biomarkers (*e.g.*, malondialdehyde) while upregulating antioxidant defenses (*e.g.*, superoxide dismutase), thereby mitigating neurovascular damage. Crucially, the interplay between these domains amplifies therapeutic efficacy: exercise-induced endorphin release reduces cravings, while improved sleep architecture lowers relapse risk by stabilizing emotional regulation networks.

Randomized trials demonstrate that integrated lifestyle interventions yield 35–50% greater improvements in sexual function metrics, addiction remission rates, and psychological well-being compared to isolated pharmacological approaches. For example, a 24-week regimen combining smoking cessation, moderate-intensity exercise, and cognitive-behavioral therapy for insomnia (CBT-I) reduced ED prevalence by 41% in nicotine-dependent males, paralleled by normalized testosterone and C-reactive protein (CRP) levels [34]. Thus, lifestyle modifications transcend adjunctive status, emerging as active therapeutic agents that recalibrate systemic physiology while empowering patient agency—a dual mechanism essential for sustainable recovery in substance abuse populations.

4.3 Psychosocial support

Cognitive-behavioral therapy or sex counseling addresses comorbid psychological stressors.

Psychosocial support, particularly through structured interventions such as cognitive-behavioral therapy (CBT) and specialized sex counseling, plays a pivotal role in mitigating comorbid psychological stressors that frequently exacerbate sexual dysfunction and hinder recovery in clinical populations. CBT, an evidence-based psychotherapeutic modality, targets maladaptive cognitive schemas and behavioral patterns—such as catastrophic thinking, performance anxiety or body dysmorphia—that perpetuate sexual avoidance and emotional distress. By employing techniques like cognitive restructuring and exposure therapy, CBT fosters adaptive coping strategies, thereby reducing arousal-inhibiting psychological barriers. Concurrently, sex counseling addresses relational dynamics and intimacy-related apprehensions through psychoeducation, communication skill-building and sensate focus exercises, which normalize sexual concerns and dismantle inhibitory myths. These interventions are particularly critical in substance abuse cohorts, where stigma, shame, and trauma histories often amplify psychological comorbidities. Randomized controlled trials demonstrate that integrating CBT or sex counseling with biomedical treatments yields 30–45% greater improvements in sexual satisfaction and adherence to therapeutic regimens compared to somatic interventions alone [35]. Furthermore, such psychosocial support attenuates relapse risk by resolving underlying affective disorders (*e.g.*, depression, Post-Traumatic Stress Disorder (PTSD)) that frequently drive substance use as maladaptive self-medication. Thus, these modalities not only alleviate immediate distress but also fortify psychological resilience, underscoring their indispensability in holistic, patient-centered care frameworks.

5. Clinical implementation guidelines

5.1 Diagnostic precision

Differentiate functional versus organic etiologies via TCM and biomedical evaluations.

In contemporary clinical practice, the ability to distinguish between functional and organic etiologies is paramount for devising effective, personalized therapeutic strategies. Functional disorders, characterized by physiological dysregulation without overt structural pathology, often manifest as syndromes such as irritable bowel syndrome, psychogenic ED or fibromyalgia. In contrast, organic pathologies arise from identifiable structural, biochemical or molecular aberrations, such as diabetic neuropathy, coronary artery disease or malignant tumors. The integration of Traditional Chinese Medicine diagnostics with biomedical evaluations offers a robust framework for achieving this differentiation, synergizing millennia-old phenomenological insights with cutting-edge technological advancements to optimize diagnostic accuracy and therapeutic outcomes.

5.1.1 TCM Diagnostic Paradigm: Holistic Pattern Differentiation

TCM's diagnostic approach, rooted in the principles of bianzheng lunzhi (pattern differentiation and treatment determination), evaluates the dynamic interplay between *Zang-Fu* organ systems, Qi (vital energy), blood circulation, and environmental influences. Functional disturbances in TCM are frequently attributed to imbalances such as Qi stagnation, blood stasis or phlegm-damp accumulation—patterns that correlate with dysautonomia, microcirculatory impairment, or neuroendocrine dysregulation in biomedical terms [36, 37]. Key diagnostic modalities include:

Pulse Palpation: The radial pulse is assessed for 28 distinct qualities (*e.g.*, wiry, thready, slippery), each reflecting specific organ interactions. For instance, a "wiry" pulse at the left guan position suggests liver Qi stagnation, often biomedically linked to sympathetic overactivity and heightened cortisol secretion.

Tongue Examination: Tongue morphology, color and coating provide insights into systemic homeostasis. A purple tongue with sublingual varicosities indicates blood stasis, correlating with endothelial dysfunction and hypercoagulability.

Symptom Clustering: TCM aggregates subjective complaints (*e.g.*, nocturnal sweating, aversion to cold) into patterns like Yin deficiency or Yang excess, which may precede detectable organic changes.

These methods excel in identifying functional etiologies—subtle, early-stage imbalances that evade conventional imaging or lab tests. For example, TCM's diagnosis of "heart-kidney noncommunication" in insomnia patients often predates polysomnographic abnormalities, reflecting subclinical autonomic dysregulation.

5.1.2 Biomedical Diagnostics: Structural and Molecular Precision

Biomedicine employs advanced technologies to detect organic pathologies with high specificity:

Imaging Modalities: MRI, CT scans and Doppler ultrasonography visualize anatomical anomalies (*e.g.*, spinal cord lesions, atherosclerotic plaques).

Laboratory Assays: Biomarkers such as C-reactive protein (CRP), glycosylated hemoglobin (HbA1c) or tumor necrosis factor-alpha (TNF-α) quantify inflammatory, metabolic, or neoplastic processes.

Electrophysiological Studies: Nerve conduction velocity tests or electroencephalograms (EEGs) diagnose neuropathies or seizure disorders. While indispensable for organic diagnoses, these tools often fail to explain functional symptoms. Up to 30% of patients with chronic fatigue or pelvic pain exhibit normal biomarkers, underscoring the limitations of a purely reductionist approach.

5.1.3 Integrative Diagnostics: Bridging Paradigms

The confluence of TCM and biomedical diagnostics addresses the limitations of each system. For instance:

- Mechanistic Correlations Between TCM Patterns and Biomedical Pathologies

Emerging research validates TCM patterns through biomedical lenses:

Liver Qi Stagnation: Correlates with elevated cortisol, reduced heart rate variability (HRV), and upregulated pro-inflammatory cytokines (IL-6, TNF-α).

Kidney Yang Deficiency: Associates with hypothalamic-pituitary-adrenal (HPA) axis hypoactivity, low IGF-1 and os-

teoporotic bone density.

Phlegm-Dampness: Linked to insulin resistance, dyslipidemia, and gut microbiota dysbiosis.

Such correlations enable clinicians to stratify patients into functional (TCM-dominant) or organic (biomedical-dominant) categories, guiding tailored interventions.

● Challenges in Integrative Diagnostics

Standardization: TCM's subjective diagnostic criteria (*e.g.*, pulse qualities) lack universal quantification, risking inter-practitioner variability.

Epistemological Divergence: TCM's focus on dynamic balance contrasts with biomedicine's lesion-centric model, complicating interdisciplinary communication.

Resource Limitations: Access to dual-trained practitioners and advanced diagnostics remains scarce in low-income regions.

● Future Directions and Innovations

Biomarker Validation: Proteomic and metabolomic studies identifying molecular signatures of TCM patterns (*e.g.*, Yin deficiency-associated oxidative stress markers).

AI-Driven Diagnostics: Machine learning algorithms analyzing tongue images, pulse waveforms and EHR data to predict TCM-biomedical correlations.

Educational Integration: Cross-training medical students in TCM pattern differentiation and biomedical diagnostics to foster collaborative care models.

5.2 Treatment protocol

Initial 4–8 weeks courses with 2–3 sessions weekly, adjusted based on progress.

The implementation of a structured treatment protocol, typically comprising an initial 4–8 weeks course with 2–3 sessions administered weekly, is grounded in evidence-based optimization of therapeutic efficacy while minimizing patient attrition. This temporal framework aligns with documented neuroplastic and vascular adaptation timelines, wherein cumulative acupuncture stimulation induces sustained modulation of hypothalamic-pituitary axis activity, endothelial eNOS upregulation, and synaptic remodeling in limbic regions. The biweekly frequency ensures sufficient stimulus intensity to overcome physiological inertia while avoiding receptor desensitization. Clinicians are advised to conduct interim assessments at weeks 4 and 8 using validated metrics—such as the International Index of Erectile Function (IIEF-5) or Hamilton Anxiety Scale (HAMA)—to quantify progress [38–40]. For partial responders (<30% improvement in primary endpoints), protocol intensification (*e.g.*, adjunctive electroacupuncture, increased session frequency to 3×/week) may be warranted. Conversely, non-responders necessitate etiological re-evaluation via Doppler ultrasonography or serum biomarker profiling to exclude occult organic pathologies [41]. Treatment personalization is further guided by individual factors including baseline autonomic tone, comorbid metabolic disorders, and medication interactions. This phased approach balances standardization with flexibility, ensuring dynamic alignment between intervention intensity and pathophysiological complexity.

5.3 Contraindications

Exercise caution in patients with coagulopathies or severe cardiovascular disease.

6. Cultural and healthcare system differences in TCM accessibility and acceptance

TCM's accessibility and acceptance depend heavily on cultural familiarity and healthcare policies. While it thrives in East Asia as a mainstream practice, it remains a complementary option in the West and a niche or unregulated therapy elsewhere. Greater scientific validation, cultural adaptation and policy support will determine its future global role.

7. Conclusion

Acupuncture offers a viable adjunct for psychogenic or functional sexual dysfunction in substance abusers. However, severe organic cases require integrated biomedical interventions. Personalized, evidence-based protocols are essential to optimize outcomes.

ABBREVIATIONS

TCM, Traditional Chinese Medicine; fMRI, functional magnetic resonance imaging; GnRH, gonadotrophin release hormone; LH, luteinizing hormone; FSH, follicle stimulating hormone; 5-HT, 5-hydroxytryptame; NADPH, nicotinamide adenine dinucleotide phosphate; TNF-α, tumor necrosis factor-α; IL-6, interleukin 6; BDNF, brain-derived neurotrophic factor; FKBP5, Tacrolimus 560; CRP, C-reactive protein; HbA1c, glycosylated hemoglobin; HPG, hypothalamic-pituitary-gonadal; eNOS, endothelial nitric oxide synthase; NO, nitric oxide; ED, erectile dysfunction; NADPH, nicotinamide adenine dinucleotide phosphate; SOD, superoxide dismutase; LR3, like Taichong; ACC, anterior cingulate cortex; ANS, autonomic nervous system; GABA, γ-aminobutyric acid; HPA, hypothalamic-pituitary-adrenal; HAMA, Hamilton Anxiety; BDI, Beck Depression Inventory; IIEF, International Index of Erectile Function; CBT, cognitive-behavioral therapy; PDE5, phosphodiesterase type 5; cGMP, clic guanosine monophosphate; ESWT, extracorporeal shockwave therapy; CRH, corticotropin-releasing hormone; ACTH, adrenocorticotropic hormone; ANS, autonomic nervous system; HRV, heart rate variability; EHRs, electronic health records; cGMP, cyclic guanosine monophosphate; IGF-1, insulin-like growth factor 1; SWS, slow-wave sleep; CBT-I, cognitivebehavioral therapy for insomnia; PTSD, Post-Traumatic Stress Disorder; EEGs, electroencephalograms.

AVAILABILITY OF DATA AND MATERIALS

The datasets used or analyzed during the current study are available from the corresponding author on reasonable request.

AUTHOR CONTRIBUTIONS

XG and BXM—designed the research study. JYZ—performed the research. LLL—provided help and advice on using DeepSeek. XG—analyzed the data. JYZ, BXM, LLL, HMG—wrote the manuscript. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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