Postprint: Technical Specifications for Electroacupuncture Therapy for Chronic Insomnia

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Abstract

Chronic insomnia is a highly prevalent sleep disorder that severely impairs daytime functioning and quality of life and is frequently comorbid with conditions such as pain, anxiety, and depression. Electroacupuncture integrates traditional needling with modern electrical stimulation technology, enhancing acupoint stimulation through continuous and controllable currents. It has demonstrated distinct advantages in the treatment of insomnia and its comorbidities, characterized by significant efficacy, standardized operation, and ease of dissemination. This protocol specifically examines therapeutic strategies of electroacupuncture for chronic insomnia and its comorbidity with pain, anxiety, and depression, providing recommendations regarding acupoint selection and combination, waveform choice, and treatment duration. At the same time, it rigorously standardizes operational procedures, clarifies indications and contraindications, and formulates emergency plans for adverse events such as needle fainting, needle stagnation, and hematoma, thereby ensuring the safety of the treatment.

Full Text

Technical Specification for Electroacupuncture Therapy in Treating Chronic Insomnia

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Abstract

Chronic insomnia is a highly prevalent sleep disorder that severely impacts daytime functioning and quality of life, and is frequently comorbid with conditions such as pain, anxiety, and depression. Electroacupuncture integrates traditional acupuncture with modern electrical stimulation technology, enhancing acupoint stimulation through continuous and controllable electrical current. This approach demonstrates unique advantages in treating insomnia and its comorbidities, characterized by significant efficacy, standardized procedures, and ease of promotion. This protocol specifically explores electroacupuncture-based therapeutic strategies for chronic insomnia and its common comorbidities—pain, anxiety, and depression. It provides targeted recommendations for acupoint combinations, waveform selection, and treatment duration. Furthermore, the protocol details the standard operating procedure, clearly defines indications and contraindications, and establishes emergency plans for managing adverse reactions, including needle fainting, stuck needle, and hematoma, thereby ensuring treatment safety.

Keywords: Insomnia; Electroacupuncture; Acupuncture needling; Technical specification

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Insomnia refers to a subjective experience of dissatisfaction with sleep duration and/or quality that affects daytime functioning or causes physical discomfort [**?**]. Recent studies indicate that 9%–15% of the population suffers from chronic insomnia [**?**]. While short-term mild insomnia poses minimal harm, persistent and severe chronic insomnia significantly increases the risk of psychiatric disorders, medication dependence or abuse, and serves as a risk factor for various somatic diseases [**?**]. The American College of Physicians recommends cognitive behavioral therapy as first-line treatment for chronic insomnia, while benzodiazepines and non-benzodiazepine hypnotics are also widely used clinically [**?**]. Traditional Chinese medicine also offers characteristic diagnostic and treatment protocols for improving insomnia. Insomnia falls under the category of "sleeplessness" in traditional Chinese medicine. Classic herbal formulas such as Suanzaoren Decoction and Guipi Decoction demonstrate significant efficacy in treating insomnia [**?**]. Acupuncture, as a distinctive non-pharmacological treatment method, offers advantages including safety, natural approach, and systemic regulation, with increasingly robust evidence from evidence-based medicine. Electroacupuncture builds upon traditional acupuncture by adding continuous electrical stimulation, effectively enhancing therapeutic efficacy with significant results, simple operation, and ease of promotion, making it an indispensable tool in insomnia diagnosis and treatment. Moreover, electroacupuncture can effectively improve

insomnia comorbid with pain, depression, and anxiety.

Treatment protocols for chronic insomnia using electroacupuncture are diverse, yet technical standards for electroacupuncture in treating insomnia remain lacking. Based on relevant literature and clinical practice, this article elaborates on acupoint compatibility, waveform selection, treatment duration, and comorbidity management for electroacupuncture treatment of chronic insomnia, providing guidance for clinical application and reference.

1 Normative References

The following documents contain provisions that constitute indispensable terms of this specification:
- GB/T 21709.20: Technical Specification for Acupuncture Manipulation—Part 20: Filiform Needle Basic Techniques
- GB/T 12346—2021: Nomenclature and Location of Meridians and Acupoints

2 Technical Introduction

Electroacupuncture therapy is a treatment method that combines traditional acupuncture with modern electrical stimulation technology. The core procedure involves inserting filiform needles into acupoints, obtaining the needling sensation (deqi) at local points, connecting electrodes to the needle handles, and applying microcurrent with specific frequency, waveform, and intensity through an electroacupuncture device to enhance acupoint stimulation, thereby regulating bodily functions and treating disease.

Clinically used electroacupuncture output waveforms include continuous wave, sparse-dense wave, and intermittent wave. Continuous wave delivers electrical pulses at a fixed, uninterrupted frequency. Historically, pulses below 30 Hz were termed sparse waves, while those above 30 Hz were called dense waves. According to China' s current national standard GB/T 21709.11-2013 (Technical Specification for Acupuncture Manipulation—Part 11: Electroacupuncture), sparse wave typically refers to 2–5 Hz pulses, while dense wave refers to 50–100 Hz pulses. Dense wave can inhibit sensory and motor nerves, commonly used for analgesia, sedation, and relieving muscle and vascular spasms. Sparse wave can excite muscles, improve muscle and ligament tension, regulate vasomotor function, improve blood circulation, and promote neuromuscular functional recovery; prolonged use inhibits sensory and motor nerves, making it suitable for treating paralysis, muscle/joint/ligament/tendon injuries, and chronic pain. Sparse-dense wave alternates between different frequencies to achieve bidirectional regulation of "inhibition" and "excitation," enhancing metabolism, promoting blood and lymph circulation, improving tissue nutrition, and eliminating inflammatory edema. It is commonly used for soft tissue injuries, periarthritis, lumbar fascia strain, sciatica, facial paralysis, muscle weakness, acupuncture anesthesia, and local frostbite. Intermittent wave is a rhythmically interrupted waveform: during the "off" phase, no pulse output occurs for 1.5 seconds; during

the "on" phase, dense wave works continuously for 1.5 seconds. This waveform is less likely to cause tolerance, has strong excitatory effects on neuromuscular function, and provides good stimulation for striated muscle contraction, commonly used in treating flaccidity syndromes and paralysis [**?**]. Waveform schematic diagrams are shown in [Figure 1: see original paper].

3 Technical Specifications

3.1 Indications and Contraindications

3.1.1 Indications

(1) **Insomnia patients** with primary symptoms including difficulty falling asleep (sleep latency >30 minutes in adults), sleep maintenance difficulty ($ $2 awakenings per night), early morning awakening, decreased sleep quality, and reduced total sleep time (typically <6 hours), occurring $ $3 times per week, and accompanied by daytime functional impairment or distress such as fatigue, low mood or irritability, physical discomfort, cognitive impairment, and anxiety symptoms [**?**]. Studies show electroacupuncture is more effective than conventional acupuncture in relieving insomnia symptoms and can effectively improve comorbidities such as chronic pain [**?**], depression [**?**], anxiety [**?**], hypertension [**?**], and stroke [**?**].

(2) **Other sleep disorders** including restless legs syndrome and sleep apnea [**?**].

3.1.2 Contraindications

(1) Patients who are excessively hungry, thirsty, fatigued, weak, emotionally agitated, or intoxicated.

(2) Patients with severe somatic diseases such as malignant tumors or serious cardiovascular, hepatic, renal, or nervous system diseases.

(3) Active epilepsy or severe epilepsy history.

(4) Hemorrhagic disorders (e.g., hemophilia) or severe coagulation dysfunction.

(5) Patients with severe suicidal, self-harming, or impulsive/aggressive behaviors in psychiatric disorders, such as acute schizophrenia, delusional disorder, or schizoaffective disorder.

(6) Avoid electroacupuncture at sites with skin infection, ulceration, or breakage.

(7) Patients with implanted pacemakers or electronic medical devices.

(8) Pregnant or lactating women.

3.2 Treatment Room Setup and Operating Procedure

3.2.1 Treatment Room Environment

(1) **Space**: The treatment room should be spacious, with at least 1.5 meters between each acupuncture bed to facilitate operator movement and emergency evacuation.

(2) **Zoning**: Functional areas should be designated, including patient waiting area, treatment area, and operator preparation area. The operator preparation area should clearly separate clean and contaminated zones (e.g., operation table surface as clean zone for needles, tissues, cotton swabs; area under table as contaminated zone for sharps containers).

(3) **Temperature and humidity**: Maintain comfortable, constant temperature (recommended 22–26°C) and humidity (recommended 50%–60%) to prevent patient discomfort from excessive cold or heat. Air conditioning and/or humidifiers should be available.

(4) **Ventilation**: The treatment room should have good ventilation with regular daily window opening. If natural ventilation is unavailable, air purification equipment should be installed.

(5) **Lighting**: Lighting should be adequate and soft, avoiding direct light. Adjustable brightness is preferred to create a relaxing atmosphere during treatment.

(6) **Privacy**: Effective screening with curtains or partitions should separate treatment units (acupuncture beds) to protect patient privacy.

(7) **Disinfection**: UV disinfection should be performed before the first treatment and after all treatments daily, with each session lasting $ $30 minutes, starting 5–7 minutes after the lamp is turned on. No personnel should remain in the room during UV exposure to prevent skin and eye burns.

3.2.2 Electroacupuncture Operating Procedure

(1) Inform patients of the procedure, screen for contraindications, and obtain cooperation.

(2) Select acupoints based on patient condition, prepare materials, and bring to bedside.

(3) Choose appropriate positioning and instruct patients to empty their bladder.

(4) After locating acupoints, press with thumb to calibrate based on soreness or pain sensation.

(5) **Pre-procedure disinfection**: Practitioners should wash hands using the seven-step method, allow to dry, then wipe hands with 75% ethanol cotton balls before needle manipulation. Disinfect patient skin at acupoints using 75% ethanol cotton balls in circular motions from center outward.

(6) Insert needles using standard filiform needle technique, manipulate to obtain deqi sensation (practitioner feels heaviness, tightness, or needle vibration; patient experiences soreness, numbness, distension, or heaviness).

(7) **Electroacupuncture operation**: Set intensity adjustment knob to zero before operation. Connect 2 wires (each group contains 2 wires of same color) to 2 needle handles, typically selecting 1–3 pairs of points on the same limb (prohibit current flow across the heart; do not connect points on both upper limbs to same electrode pair). Turn on power, select waveform, and gradually increase intensity from low to high. When current reaches a certain intensity, patients experience numbness or tingling—this is the "sensory threshold." Further slight increase may cause sudden pain; the optimal therapeutic intensity lies between sensory and pain thresholds. Intensity should generally be tolerable for patients.

(8) **Post-procedure**: Turn off electroacupuncture device, remove wires from needle handles, prepare sterile cotton balls, remove all needles while pressing needle holes, dispose needles in sharps container. All used sterile items should be treated as medical waste.

The electroacupuncture procedure is illustrated in [Figure 2: see original paper].

3.3 Treatment Parameters

3.3.1 Acupoint Selection Primary acupoints commonly selected include Shenmen (HT7), Sanyinjiao (SP6), Baihui (GV20), Yintang (EX-HN3), Sishencong (EX-HN1), Anmian (EX-HN22), Shenting (GV24), and Zhaohai (KI6), following the core principle of regulating spirit to aid sleep [**?**], as shown in [Figure 3: see original paper]. Among these, Shenmen is the most frequently used core point, Sanyinjiao and Baihui are secondary core points, and head/face calming points and extraordinary points such as Sishencong, Yintang, Shenting, and some experiential calming points constitute high-frequency combination points. Individualized modifications can be made based on pattern differentiation and comorbidities [**?**]. Clinical compatibility should consider pattern

types: for heart-spleen deficiency, add Zusanli (ST36), Pishu (BL20); for liver fire disturbing the spirit, add Taichong (LR3), Xingjian (LR2); for heart-kidney disharmony, add Taixi (KI3), Daling (PC7); for heart-gallbladder qi deficiency, add Xinshu (BL15), Danshu (BL19).

3.3.2 Waveform Selection Common waveforms for primary insomnia include continuous wave, sparse-dense wave, and intermittent wave, mostly based on practitioner experience, with continuous wave being most common [**?**]. Treatment parameters for electroacupuncture in insomnia commonly use continuous wave, though both dense and sparse wave applications show diversity, and both are acceptable.

3.3.3 Treatment Duration Electroacupuncture treatment for insomnia is recommended for 30–45 minutes [**?**]. Studies show afternoon treatment yields better results than morning treatment for chronic insomnia patients [**?**]. Treatment frequency is not necessarily better when more intensive; every-other-day treatment shows superior results compared to daily treatment [**?**]. Therefore, treatment frequency of 3–6 times per week is recommended.

3.3.4 Efficacy Evaluation Sleep and psychological scale assessment: Evaluate insomnia patients before and after treatment using sleep and psychological scales. Primary scales include Pittsburgh Sleep Quality Index (PSQI), Insomnia Severity Index (ISI), Dysfunctional Beliefs and Attitudes about Sleep Scale (DBAS), Pre-sleep Arousal Scale (PSAS), and Sleep Disorders Questionnaire (SDQ).

Polysomnography (PSG) is the "gold standard" in sleep medicine:
- **Electroencephalogram (EEG)**: Core basis for objective sleep staging (N1, N2, N3 slow-wave sleep, rapid eye movement sleep) and sleep onset time determination.
- **Electrooculogram (EOG)**: Monitors eye movements to identify rapid eye movement sleep.
- **Electromyogram (EMG)**: Monitors muscle activity (e.g., jaw muscles) to identify rapid eye movement sleep and periodic limb movements, providing key diagnostic information for periodic limb movement disorder.
- **Electrocardiogram (ECG)**: Monitors heart rate changes throughout the night.
- **Respiratory monitoring**: Monitors respiratory events through nasal/oral airflow and thoracoabdominal effort to exclude sleep apnea syndrome.
- **Blood oxygen saturation**: Monitors nocturnal oxygen levels to assist respiratory diagnosis.
- **Leg movement monitoring**: Objectively records periodic limb movements during sleep.

3.3.5 Comorbidity Management 3.3.5.1 Chronic Insomnia Comorbid with Pain: Chronic insomnia and pain are highly comorbid, with 9%–15%

of the population suffering from chronic insomnia [**?**], approximately 50% of insomnia patients having chronic pain, and about 50% of chronic pain patients having insomnia or clinically significant sleep disorders [**?**]. Compared with traditional acupuncture, adding electroacupuncture provides better analgesic effects.

Acupoint selection: Current electroacupuncture treatment for pain-insomnia comorbidity primarily combines sleep-regulating points with local pain points. Main points include Shenmen, Yintang, Sishencong, Anmian, Baihui, Neiguan (PC6), Zusanli, Sanyinjiao, combined with local Ashi points [**?**]. For headache: Fengchi (GB20), Baihui, Sishencong, Touwei (ST8), Taiyang (EX-HN5), Hegu (LI4), Taichong based on meridian and symptom differentiation. For neck pain: cervical Jiaji points, Tianzhu (BL10), Houxi (SI3), Shenmai (BL62). For shoulder pain: Jianyu (LI15), Jianliao (TE14), Jianzhen (SI9), Tianzong (SI11), Hegu, Quchi (LI11), Yanglingquan (GB34). For low back pain: Shenshu (BL23), Dachangshu (BL25), Weizhong (BL40). For stomach pain: Zusanli, Neiguan, Zhongwan (CV12). For abdominal pain: Zusanli, Tianshu (ST25), Guanyuan (CV4). For knee pain: Xiyan (EX-LE5), Liangqiu (ST34), Xuehai (SP10), Yanglingquan, Dazhu (BL11). For ankle pain: Sanyinjiao, Zhaohai, Shangqiu (SP5), Xuanzhong (GB39), Shenmai, Qiuxu (GB40).

Waveform selection: High-frequency dense wave is optimal for acute pain, commonly used for analgesia, sedation, and relieving muscle/vascular spasms, while low-frequency sparse wave is more suitable for chronic pain [**?**]. Waveforms for pain management primarily use sparse-dense wave or continuous wave. For example, dense wave may be used initially for immediate analgesia, then switched to sparse wave to maintain analgesic effect [**?**]. Sparse-dense wave, a combination of alternating sparse and dense waves, produces immediate and delayed inhibition of sensory and motor nerves, exerting strong analgesic effects while preventing tissue adaptation. Therefore, sparse-dense wave is recommended as the primary waveform for chronic insomnia with pain to improve both insomnia and pain symptoms.

Treatment duration: Electroacupuncture for insomnia-pain comorbidity should last approximately 30 minutes. Human pain threshold or pain tolerance typically reaches maximum after 20–40 minutes of needling; continued manipulation or electrical stimulation maintains analgesia at high levels. After needle removal, pain threshold recovers exponentially with a half-life of approximately 16 minutes [**?**]. Low-frequency electroacupuncture requires a 15-minute latent period before analgesic effects appear, peaking at 45 minutes. Beyond 45 minutes, analgesia can be maintained but gradually weakens [**?**].

3.3.5.2 Chronic Insomnia Comorbid with Anxiety: Anxiety and insomnia are closely related, with increasing prevalence due to modern lifestyle pressures. Studies show approximately 32.5% of chronic insomnia patients have comorbid anxiety [**?**], severely impacting productivity and quality of life. Electroacupuncture offers significant advantages in safety and natural approach for treating insomnia with anxiety, effectively improving sleep quality and relieving anxi-

ety.

Acupoint selection: Shenmen and Sanyinjiao are frequently used in treating insomnia with anxiety, with Shenmen being most common [**?**]. Points such as Baihui, Shenting, Yintang, Anmian, Shenmen, Zusanli, and Sanyinjiao show significant advantages in efficacy and sustainability [**?**].

Waveform selection: Optimal electroacupuncture waveforms for insomnia with anxiety are not well-established, but current research suggests prioritizing sparse-dense wave or continuous wave [**?**].

Treatment duration: Recommended treatment time is 30 minutes for 2–4 weeks.

3.3.5.3 Chronic Insomnia Comorbid with Depression: The prevalence of depression in insomnia patients is 3–4 times higher than in non-insomnia patients, with approximately 70% of depressed patients experiencing insomnia symptoms [**?**]. Electroacupuncture has become an essential treatment option for chronic insomnia with depression.

Acupoint selection: Point selection is diverse; recommended main points include Baihui, Sishencong, Shenmen, Yintang, Shenting, Anmian, Neiguan, Sanyinjiao, and Taichong [**?**]. Additionally, back-shu points play important roles [**?**].

Waveform selection: Research on optimal waveforms is limited, but most studies use continuous wave or sparse-dense wave, with diverse continuous wave frequencies [**?**].

Treatment duration: Recommended treatment time is 30–40 minutes for 2–4 weeks [**?**].

4 Adverse Reactions

4.1 Mild Discomfort Reactions (e.g., mild dizziness, palpitations, sweating, fatigue)

Identification: These reactions are mild, with clear consciousness and ability to communicate normally with practitioners. Must be distinguished from pre-fainting signs, which typically include pale complexion and nausea.

Management: (1) Immediately reduce electroacupuncture intensity to "0" or minimal tolerable stimulation. (2) Comfort patient to relieve tension; instruct relaxation and steady deep breathing. (3) Measure vital signs if possible: blood pressure and heart rate to assess overall condition. In most cases, symptoms resolve quickly with above measures. After complete resolution, decide whether to continue treatment or reduce parameters based on patient condition.

4.2 Agitation, Tension, or Intolerance

Identification: Patients appear irritable and anxious, reporting unbearable stimulation intensity, with involuntary muscle tension or contraction.

Management: (1) Reduce electroacupuncture frequency and intensity, or switch to gentler waveforms like sparse-dense wave. (2) Explain patiently and guide relaxation. (3) Check if needles contact nerve trunks; slightly adjust depth or direction. (4) Inquire about hypoglycemia, extreme fatigue, or emotional instability. (5) Measure blood glucose if necessary, especially in diabetic patients or those receiving treatment on an empty stomach. (6) If intolerance persists after adjustment, stop electrical stimulation and retain needles or remove them.

4.3 Needle Fainting

Identification: Electroacupuncture carries risk of needle fainting—syncope during treatment. Mild cases present with mental fatigue, dizziness, nausea, pale complexion, palpitations, and sweating; severe cases may show transient loss of consciousness, cold extremities, and blood pressure drop.

Management: (1) Immediately set electroacupuncture output to "0," turn off power, and remove all needles. (2) Assist patient to lie supine with head lowered; loosen collar and keep warm. Mild cases recover after drinking warm water or sugar water. Severe cases may require acupuncture or pressure at Renzhong (GV26), Neiguan (PC6), or other emergency measures.

4.4 Stuck Needle

Identification: Needle is difficult to rotate, lift, or withdraw, causing patient pain.

Management: (1) Instruct patient to relax and relieve tension. (2) Slightly extend needle retention time, or perform gentle tapping/flicking around stuck acupoint. If caused by unidirectional rotation, rotate in opposite direction. (3) If necessary, insert another needle nearby to relieve muscle spasm, then remove the stuck needle.

4.5 Hematoma/Subcutaneous Hemorrhage

Identification: Swelling and pain at needling site with skin discoloration after needle removal.

Management: For minimal localized bruising, no special treatment is needed as it resolves spontaneously; explain to patient to alleviate concerns. For significant swelling, pain, or large bruised area: immediately press bleeding point with sterile cotton ball for 3–5 minutes after needle removal; apply cold compress within 24 hours to constrict vessels and relieve pain; after 24 hours, switch to warm compress or gentle massage to promote absorption.

5 Other Considerations

Before treatment, inform patients of the procedure to relieve tension and obtain cooperation. During treatment, adjust current gradually without sudden in-

creases that may cause strong muscle contractions, needle bending, or breakage. Stimulation intensity should be patient-tolerable. When using electroacupuncture near medulla oblongata or spinal cord, use minimal current and ensure current loops do not cross the central nervous system; avoid excessive stimulation. After treatment, inquire about discomfort and schedule next appointment.

Electroacupuncture offers advantages of high safety, minimal adverse reactions, and high patient acceptance as a non-pharmacological intervention, particularly suitable for patients with long-term medication restrictions or multiple somatic diseases. However, current research has limitations including insufficient parameter standardization, high heterogeneity between studies, limited high-quality randomized controlled trials, and restricted generalizability of conclusions. Future research should conduct multicenter, large-sample randomized controlled trials to systematically compare different electroacupuncture parameters (e.g., sparse-dense vs. continuous wave; low- vs. high-frequency stimulation; different durations and courses) regarding effects on sleep quality, daytime function, and long-term prognosis, to further optimize treatment parameters (waveform, frequency, course) and standardize protocols. Building upon existing neuroimaging and neurophysiological studies, future work should integrate multimodal technologies including functional magnetic resonance imaging, electroencephalography, magnetoencephalography, and near-infrared spectroscopy to dynamically observe brain functional network remodeling (e.g., default mode network, amygdala-prefrontal circuits) during electroacupuncture intervention. This will help elucidate central mechanisms involving neurobiology, neuroimmunology, and neuroendocrinology, ultimately constructing individualized precision treatment pathways integrating traditional Chinese medicine "pattern differentiation" and modern medicine "disease diagnosis."

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Note: Figure translations are in progress. See original paper for figures.