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Original Article

Acupotomy at spinal acupoints for primary insomnia: an exploration of therapeutic effectiveness

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Abstract: Objective: To analyze the therapeutic effectiveness of acupotomy at spinal acupoints for primary insomnia (PI). Methods: A total of 185 PI patients were divided into a control group (90 cases treated with Zolpidem Tartrate Tablets) and a research group (95 cases treated with acupotomy at spinal acupoints) based on different treatment modalities. We collected the following clinical data of patients for comparative analysis: therapeutic effectiveness, sleep quality (Pittsburgh Sleep Quality Index [PSQI], Insomnia Severity Index [ISI]), hyperarousal status (Pre-Sleep Arousal Scale [PSAS], Hyperarousal Scale [HAS]), sleep-related indices (sleep latency, actual sleep duration, number of awakenings), adverse mood (Self-Rating Anxiety Scale [SAS], Beck Depression Inventory [BDI]), serum neurotransmitters (glutamic acid [GA], gamma-aminobutyric acid [GABA]), adverse reactions (postoperative pain or soreness, local hematoma or ecchymosis, dizziness or vertigo, daytime drowsiness or lethargy, nausea or stomach upset, hypomnesia), and quality of life. Results: The data showed that the overall response rate was significantly higher in the research group than in the control group ($P<0.05$). In addition, after treatment, the PSQI, ISI, PSAS, HAS scores, sleep latency, number of awakenings, SAS, BDI scores, and total adverse reaction rate in the research group were significantly lower, while the actual sleep duration, GA, and GABA levels were significantly higher (all $P<0.05$). Conclusion: The findings confirm that acupotomy at spinal acupoints can improve the therapeutic effectiveness in patients with PI.

Keywords: Acupotomy at spinal acupoints, primary insomnia, therapeutic effectiveness, clinical efficacy analysis

Introduction

Primary insomnia (PI), a non-secondary sleep disorder, is not associated with any drug effects, physical illnesses, or mental disorders [1]. Patients with PI experience difficulty falling asleep, poor sleep quality, early awakening, and difficulty resuming sleep after awakening. Its pathogenesis may involve changes in intestinal microflora, as well as disorders of insulin signaling, flavonoid biosynthesis, ascorbic acid metabolism, and aldehyde acid metabolism [2]. Epidemiologically, a remarkably high proportion of people suffer from sleep disorders - 50% of those over 60 years old and 20% of young people [3]. PI impairs patients' health, work efficiency, and quality of life (QoL) [4, 5]. Currently, the main treatment approaches for PI include pharmacological and non-pharmacological interventions (mainly cognitive behavioral therapy). Although non-pharmacological interventions have more favorable long-term curative effects, they rely heavily on patient compliance, with only 33% of cases achieving successful treatment [6]. Currently, hypnotic drugs for PI mainly include gamma-aminobutyric acid (GABA) modulators (e.g., benzodiazepines, benzodiazepine receptor agonists), melatonin agonists, sedative antidepressants, and orexin receptor antagonists. Zolpidem Tartrate Tablets belong to the benzodiazepine receptor agonist category. Although effective, they may be accompanied by adverse reactions such as dizziness and fatigue, as well as drug dependence [7, 8]. Acupotomy at spinal acupoints is a minimally invasive technique based on the meridian

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theory of traditional Chinese medicine. By selecting spinal acupoints and performing release and lysis with an acupotomy, it can dredge meridians, harmonize qi and blood, relieve muscle spasms, and improve local blood circulation [9, 10]. Characterized by precise manipulation, obvious needling sensation, short operation time, and rapid response, it can not only stimulate acupoints and regulate meridians like an acupuncture needle but also cut, strip, and release like a scalpel [11]. Currently, little is known about the mechanism of acupotomy at spinal acupoints in the treatment of PI. This study aims to conduct an analysis to verify the potential clinical advantages of this therapy.

Materials and methods

Case selection

A total of 185 PI patients admitted to the Second Affiliated Hospital of Guangzhou University of Traditional Chinese Medicine constituted the study population, with their enrollment period from July 2022 to July 2025. Patients were divided into a control group (90 cases treated with Zolpidem Tartrate Tablets) and a research group (95 cases treated with acupotomy at spinal acupoints) based on different treatment modalities.

This retrospective study was approved by the Ethics Committee of the Second Affiliated Hospital of Guangzhou University of Traditional Chinese Medicine.

Patient selection was performed according to the following criteria:

Inclusion criteria: (1) Confirmed diagnosis of PI [12]; (2) Disease course of no less than one month; (3) Patients voluntarily signed informed consent and tolerated relevant treatment; (4) Insomnia induced by non-organic factors; (5) Normal communication ability and cognitive function; (6) Complete available clinical data.

Exclusion criteria: (1) History of infectious diseases such as hepatitis B, tuberculosis and hepatitis C; (2) Transient insomnia caused by unhealthy lifestyles (e.g. drinking strong tea or coffee before sleep) or environmental changes (e.g. external noise, unfamiliar living environment); (3) Receiving psychotropic drugs within 2 weeks before enrollment; (4) Breastfeeding or pregnant women; (5) Dependence on sedative and hypnotic drugs; (6) Combined cardiovascular diseases, severe endocrine disorders, hepatorenal insufficiency, severe osteoporosis, malignant tumors, coagulation disorders, drug allergy to study medications or mental disorders; (7) Having acupotomy contraindications, including damaged, infected or ulcerated skin at treatment sites; (8) Long-term users of anticoagulants such as aspirin, warfarin and clopidogrel who cannot stop medication or have uncorrected coagulation dysfunction; (9) Uncontrolled hypertension (systolic blood pressure >160 mmHg, diastolic blood pressure >100 mmHg); (10) Severe diabetes with poor glycemic control (fasting blood glucose >11.1 mmol/L).

Intervention methods

The control group received Zolpidem Tartrate Tablets at a dose of 10 mg once daily for 4 weeks.

The research group was treated with acupotomy at spinal acupoints. Pre-treatment evaluation: The patients' bilateral cervical vertebrae (C1-C7), suboccipital triangle, and cervicothoracic junction were palpated to identify positive reaction points (tenderness, cord-like induration, and nodules). Tenderness was confirmed by a Visual Analogue Scale (VAS; 0-10 scale) score ≥3, accompanied by painful expressions or withdrawal reactions during palpation. Cord-like induration was defined as a palpable cord-like structure with clear boundaries from surrounding tissues and a diameter ≥2 mm. Nodules were defined as round or quasi-round masses with a diameter of ≥3 mm. Combined with cervical X-rays or magnetic resonance imaging (MRI), local contraindications related to the operation site (e.g., atlanto-occipital malformation, tumor, infection) were excluded. The cervicothoracic junction and posterior cervical triangle were selected as therapeutic targets. Specifically, the selected points included the posterior tubercle of C1/C2 (1.5-2.0 cm beside the superior edge of the axis spinous process, to release the attachment point of the suboccipital muscle group), C2-C3 interspinous space (between the C2 and C3 spinous processes on the posterior midline), C4-C5 Jiaji acupoints (0.5 inches lateral to the C4 and C5 spinous processes), C7-T1 Jiaji acupoints (0.5 inches lateral to the C7 and T1 spinous processes),

and Fengchi acupoint (located below the occipital bone, in the depression formed by the sternocleidomastoid muscle and the upper end of the trapezius muscle). Six to eight points were selected based on the positive reaction points (tenderness, cord-like induration, and nodules) for each treatment.

The patient was placed in a prone position (with a thin pillow placed on the chest to flex the cervical vertebrae). The surgical area was routinely disinfected and covered with sterile drapes. A Type I No. 4 needle-knife (diameter: 0.6 mm) was used, with the knife edge parallel to the direction of muscle fibers and neurovascular bundles. The needle body was quickly and vertically inserted into the skin, then advanced at a uniform speed to the deep fascia layer or bone surface. When induration or tense fascia was encountered, "longitudinal lysis and release" was performed 2-3 times and "transverse stripping and dissection" 1-2 times, followed by needle withdrawal once a loosening sensation was felt under the needle. For the Fengchi acupoint, the needle was inserted inward and downward toward the nasal apex to a depth of approximately 20-30 mm. After reaching the occipital surface, gentle cutting was performed 3 times to release the aponeurosis. The needle insertion depth at C7-T1 Jiaji acupoints was controlled at 20-25 mm. After reaching the spinous process bone surface, the direction of the needle-knife was adjusted laterally and inferiorly by no more than 15 mm to avoid pneumothorax caused by penetration into the intercostal space. For the Fengchi acupoint, the needle-knife was not inserted superomedially to prevent injury to the vertebral artery or medulla oblongata. After needle withdrawal, the needle hole was pressed for 1-2 minutes to prevent bleeding, then covered with a sterile band-aid. Treatment course: The therapy was administered once weekly for 4 weeks (i.e., on days 1, 8, 15, and 22). Curative effects were evaluated after treatment completion. After the procedure, patients were instructed to keep the needle hole dry for 24 hours. Patients were also informed of common postoperative reactions (e.g., local soreness or fatigue within 1-2 days after acupotomy), which required no special treatment. Additionally, adverse reactions (e.g., subcutaneous hematoma, premonitory symptoms of needle syncope) were monitored for prompt intervention. All acupotomy operations were performed by physicians with a professional background in traditional Chinese medicine or acupuncture, holding a practicing physician qualification, and having >3 years of clinical experience in acupotomy. Before the operation, they had received specialized training (≥40 class hours) in the treatment of cervical diseases and passed the examination.

Data collection and outcome measures

Clinical efficacy [13]. According to the total reduction rate of the Pittsburgh Sleep Quality Index (PSQI) score following 4 weeks of treatment (formula: [pre-treatment score - post-treatment score]/pre-treatment score × 100%), the curative effect evaluation criteria were established as follows: clinical control: total PSQI score reduction rate >75%, with essentially normalized sleep; marked response: total PSQI score reduction rate 50%-70%, with significantly relieved sleep problems; response: total PSQI score reduction rate 25%≤ reduction rate <50%, with improved sleep quality; non-response: total PSQI score reduction rate <25%, with persistent or worsened sleep problems. Overall response rate (ORR) = clinical control rate + marked response rate + response rate.

Sleep quality [14]. Sleep quality was assessed in all participants before and 4 weeks after treatment using the PSQI and Insomnia Severity Index (ISI). The PSQI includes seven dimensions: sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, hypnotic drug use, and daytime dysfunction (0-3 points per dimension), with a total score of 21 points. The ISI has a maximum score of 28. Higher scores on both scales indicate worse sleep quality.

Hyperarousal status [15]. Before treatment and after treatment completion, patients' hyperarousal status was evaluated using the Pre-Sleep Arousal Scale (PSAS; score range: 16-80) and the Hyperarousal Scale (HAS; score range: 0-78). Scores on both scales are positively correlated with the degree of cortical arousal.

Sleep-related indices. Sleep latency, actual sleep duration, and number of awakenings were recorded in both groups before and 4 weeks after treatment.

Adverse mood [16]. Anxiety and depression were assessed using the Self-rating Anxiety Scale (SAS) and Beck Depression Inventory (BDI), respectively. The 20-item SAS consists of 15 positive-scoring items and 5 reverse-scoring items, all graded into 4 levels based on symptom frequency, with a score range of 20-80. The BDI includes 21 items (0-3 points each), with a score range of 0-63. Higher scores on both scales indicate more severe symptoms.

Serum neurotransmitters (NTs). Before and after treatment, each patient underwent venipuncture to collect 2 mL of fasting venous blood, and serum was separated by centrifugation. Enzyme-linked immunosorbent assay (ELISA) was used to quantify serum glutamic acid (GA) and gamma-aminobutyric acid (GABA) levels. The operation strictly followed the instructions of the corresponding human ELISA kits (GA: Shanghai Zhen Ke Biological Technology Co., Ltd., ZK-3083; limit of detection: 0.05 μmol/L; intra-batch coefficient of variation [CV]: <8%; inter-batch CV: <10%; GABA: Guangzhou Aoruida Biotechnology Co., Ltd., ARD10855; limit of detection: 0.1 μmol/L; intra-batch CV: <9%; inter-batch CV: <12%).

Adverse reactions. Observed adverse reactions included postoperative pain or soreness, local hematoma or ecchymosis, dizziness or vertigo, daytime drowsiness or lethargy, nausea or stomach upset, and hypomnesia. The incidence of each adverse reaction was calculated.

QoL [17]. Patients' QoL was assessed using the World Health Organization Quality of Life-BREF (WHOQOL-BREF), which evaluates four domains: physiology, psychology, social relationships, and environment (4-20 points per domain). Higher scores indicate better QoL.

Statistical methods

The Shapiro-Wilk test was used to test the normality of measurement data. Data conforming to normal distribution were expressed as mean ± standard deviation, with independent sample t-tests for inter-group comparisons and paired t-tests for intra-group comparisons before and after intervention. Data not conforming to normal distribution were expressed as median (interquartile range [M(Q1, Q3)]), with Mann-Whitney U test for inter-group comparisons and Wilcoxon signed-rank test for intra-group comparisons. Count data were expressed as counts/percentages (n/%) and compared between groups using the χ^2 test. SPSS 24.0 software was used for data analysis. A *P* value <0.05 was considered statistically significant.

Results

Comparative analysis of baseline data

Baseline data of patients, including sex, age, disease course, body mass index (BMI), occupation, education level, night owl behavior, and drinking habits, were comparable between the two groups (P>0.05). See **Table 1**.

Comparative analysis of clinical efficacy

In the control group, 2 patients achieved clinical control, 22 achieved marked response, 33 achieved response, and 33 achieved non-response. In the research group, 10 patients achieved clinical control, 52 achieved marked response, 26 achieved response, and 7 achieved non-response. Inter-group comparison showed that the research group had a significantly higher ORR than the control group (P<0.001). See **Table 2**.

Comparative assessment of sleep quality

Sleep quality assessment using PSQI and ISI showed no significant difference in baseline scores between the two groups (P>0.05). After treatment, scores in all domains of both scales decreased significantly, and the research group had lower PSQI and ISI scores than the control group (P<0.001). See **Table 3**.

Comparative analysis of hyperarousal status

Evaluation using PSAS and HAS showed no significant difference in baseline scores between the two groups (both P>0.05). After treatment, scores of both scales decreased significantly in both groups, and the research group had lower scores than the control group (both P<0.001). See **Table 4**.

Comparative analysis of sleep-related indices

Before treatment, there were no significant differences in sleep latency, actual sleep duration,

Table 1. Comparative analysis of baseline data

Data	Control group (n=90)	Research group (n=95)	χ^2/t	P
Sex			0.201	0.654
Male	13 (14.44)	16 (16.84)		
Female	77 (85.56)	79 (83.16)		
Age (years)	44.01±9.54	41.71±10.27	1.576	0.117
Disease duration (months)	99.30±60.07	107.40±61.70	0.904	0.367
Body mass index (kg/m^2)	22.74±2.34	23.08±2.48	0.958	0.339
Job category			2.753	0.097
Mental labor	30 (33.33)	43 (45.26)		
Manual labor	60 (66.67)	52 (54.74)		
Education level			0.601	0438
Below senior high school	47 (52.22)	55 (57.89)		
Senior high school or above	43 (47.78)	40 (42.11)		
Night owl behavior			1.796	0.407
<1 time/week	28 (31.11)	22 (23.16)		
1-2 times/week	25 (27.78)	26 (27.37)		
≥3 times/week	37 (41.11)	47 (49.47)		
Alcohol drinking pattern			0.805	0.669
<1 time/week	50 (55.56)	57 (60.00)		
1-2 times/week	16 (17.78)	18 (18.95)		
≥3 times/week	24 (26.67)	20 (21.05)		

Table 2. Comparative analysis of clinical efficacy

Clinical efficacy	Control group (n=90)	Research group (n=95)	χ^2	P
Clinical control	2 (2.22)	10 (10.53)		
Marked response	22 (24.44)	52 (54.74)		
Response	33 (36.67)	26 (27.37)		
Non-response	33 (36.67)	7 (7.37)		
Overall response	57 (63.33)	88 (92.63)	23.410	<0.001

or number of awakenings between the two groups (all P>0.05). Treatment resulted in shortened sleep latency, reduced number of awakenings, and prolonged actual sleep duration in both groups. In particular, the research group had shorter sleep latency, fewer awakenings, and longer actual sleep duration than the control group (all P<0.05). See **Figure 1**.

Comparative evaluation of adverse mood

Adverse mood assessment using SAS and BDI showed no significant inter-group difference in pre-treatment scores (both P>0.05). After treatment, SAS and BDI scores decreased significantly in both groups (both P<0.05), and the research group had lower scores than the control group (both P<0.01). See **Table 5**.

Comparative analysis of serum NTs

Evaluation of serum NT levels showed no significant difference in baseline GA and GABA levels between the two groups (both P>0.05). After treatment, GA and GABA levels increased significantly in both groups (both P<0.05), with a more significant increase in the research group (both P<0.05). See **Figure 2**.

Comparative analysis of adverse reactions

Evaluation of adverse reactions showed that the total incidence of adverse reactions (including local hematoma or ecchymosis, dizziness or vertigo, daytime drowsiness or lethargy, nausea or stomach upset, and hypomnesia) was significantly lower in the research group than in the control group (P=0.004). In the research group, 20 patients experienced postoperative pain or soreness: 15 were mild (VAS score: 1-3) and 5 were moderate (VAS score: 4-6), all of which resolved spontaneously within 2-5 days after treatment without medication. Among 15

Table 3. Comparative analysis of sleep quality

Sleep quality	Control group (n=90)	Research group (n=95)	t	P
PSQI (points; pre-treatment)	12.22±2.93	12.12±3.01	0.229	0.819
PSQI (points; post-treatment)	8.02±3.26	6.13±2.04	4.753	<0.001
ISI (points; pre-treatment)	13.80±3.92	14.48±4.12	1.149	0.252
ISI (points; post-treatment)	9.82±3.43	7.33±3.05	5.224	<0.001

Note: PSQI, Pittsburgh Sleep Quality Index; ISI, Insomnia Severity Index.

Table 4. Comparative analysis of hyperarousal status

Hyperarousal assessment	Control group (n=90)	Research group (n=95)	t	P
PSAS (points; pre-treatment)	41.76±5.21	42.17±4.30	0.585	0.559
PSAS (points; post-treatment)	37.93±3.39	34.77±2.81	6.917	<0.001
HAS (points; pre-treatment)	40.06±4.07	39.85±4.70	0.324	0.746
HAS (points; post-treatment)	34.72±4.09	31.95±3.71	4.829	<0.001

Note: PSAS, Pre-Sleep Arousal Scale; HAS, Hyperarousal Scale.

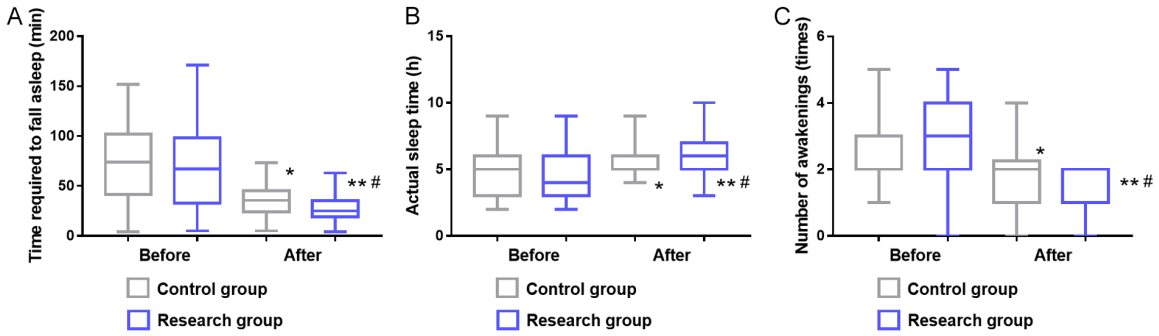

Figure 1. Comparative analysis of sleep-related indices. A. Pre- and post-treatment time required for falling asleep across groups. B. Actual sleep duration pre- and post-treatment. C. Number of awakenings pre- and post-treatment. Note: *P<0.05, **P<0.01 vs. pre-treatment; #P<0.05 vs. Control.

Table 5. Comparative adverse mood analysis

Adverse mood	Control group (n=90)	Research group (n=95)	Z/t	P
SAS (points; pre-treatment)	29.62±4.51	29.31±4.78	0.453	0.651
SAS (points; post-treatment)	28.24±3.90	26.35±3.40	3.519	<0.001
BDI (points; pre-treatment)	5.00 (3.00, 7.00)	5.00 (4.00, 7.00)	-1.457	0.145
BDI (points; post-treatment)	3.00 (2.00, 4.00)	2.00 (1.00, 3.00)	-3.450	0.001

Note: SAS, Self-Rating Anxiety Scale; BDI, Beck Depression Inventory.

cases of local hematoma or ecchymosis, 12 had localized ecchymosis around the needle hole (diameter <3 cm), and 3 had mild hematoma (diameter 3-5 cm), which subsided within 1 week after cold compress and pressure application. In the control group, 20 cases of dizziness or vertigo and 28 cases of daytime drowsiness were reported, which were considered to be induced by oral medication; 6 patients discontinued treatment prematurely due to severe drowsiness that seriously affected their daytime work. No serious adverse events (e.g., needle breakage, nerve injury, pneumothorax, infection) were reported in either group. See **Table 6**.

Comparative assessment of QoL

Baseline WHOQOL-BREF scores in all domains were comparable between the two groups (all P>0.05). After treatment, scores in all domains increased significantly in both groups

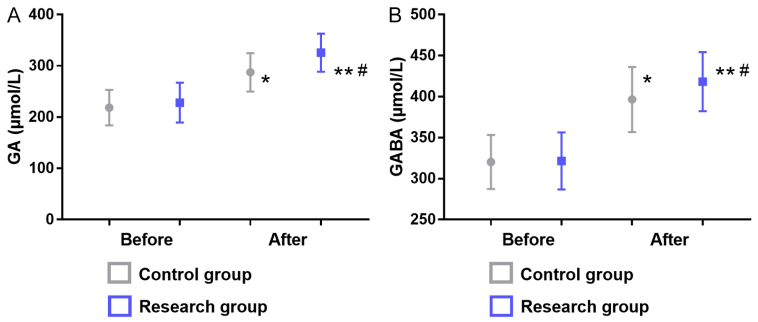

Figure 2. Comparative analysis of serum neurotransmitters. A. Pre- and post-treatment GA. B. GABA changes pre- and post-treatment. Note: *P<0.05, **P<0.01 vs. pre-treatment; #P<0.05 vs. Control. GA, glutamic acid; GABA, gamma-aminobutyric acid.

(all P<0.05), with a more significant increase in the research group (all P<0.05). See **Figure 3**.

Discussion

First of all, acupotomy at spinal acupoints was found to be more effective than Zolpidem Tartrate Tablets in the treatment of PI, effectively relieving insomnia symptoms and improving sleep quality. In addition, this non-pharmacological intervention was more effective in reducing abnormal cortical arousal levels in PI patients, reducing their pre-sleep cognitive and physiological excitement, and promoting faster sleep initiation, thereby enhancing the stability and continuity of sleep; this helps explain the higher overall effectiveness of acupotomy at spinal acupoints. Needle-knife release of the attachment point of the suboccipital muscle group at the posterior tubercle of C1/C2 and the aponeurosis at the Fengchi acupoint helps reduce muscle spindle tension and muscle tone, as well as inhibit brainstem excitement and cortical awakening [18, 19]. Further evaluation and analysis indicated that acupotomy at spinal acupoints can significantly shorten sleep latency, reduce the number of awakenings, and prolong actual sleep duration. This may be attributed to the inhibitory effect of this therapy on cortical arousal disorders. Furthermore, the stimulation of the C4-5 and C7-T1 Jiaji acupoints by acupotomy at spinal acupoints corresponds to the middle cervical sympathetic ganglion and stellate ganglion, respectively, which helps reduce excessive excitement of the head/neck blood vessels and the cardiac sympathetic nerve center, thereby promoting rapid sleep, prolonging total sleep duration, and reducing the number of nighttime awakenings [20, 21].

Psychological evaluation statistics showed that acupotomy at spinal acupoints was more helpful in relieving anxiety and depression in PI patients. This may be related to the more effective relief of insomnia symptoms in patients treated with acupotomy at spinal acupoints, which is conducive to relaxing the body and mind and reducing adverse mood. Additionally, acupotomy directly acts on positive reaction points to release contracted myofascia, which helps relieve patients' physical discomfort and chronic neck and shoulder pain, thereby contributing to the mitigation of negative emotions [22]. One study noted that acupotomy at spinal acupoints can promote resting-state functional connectivity of the emotional network, thereby improving emotional regulation and sleep quality [23]. This is consistent with our findings and also provides an explanation for the potential mechanism of acupotomy in the treatment of PI. Moreover, treatment of PI with acupotomy at spinal acupoints effectively upregulated GA and GABA levels in patients. Among them, GA can mediate the overall sleep-wake cycle, including sleep initiation, circadian rhythm, generation of sleep slow-wave oscillations, and sleep maintenance [24]. GABA can inhibit excessive discharge and excitatory conduction of nerve cells [25]. Both GA and GABA are central nervous system inhibitory NTs, and their increased levels help improve the sleep quality of PI patients. This is because the release of the cervical deep fascia at the C2-C3 interspinous space and posterior tubercle of C1/C2 improves the vertebral-basilar artery blood supply of patients and ensures the blood supply of the sleep center, which is conducive to restoring the normal synthesis and release of GA and GABA [26]. Statistics on adverse reactions showed that PI patients treated with acupotomy at spinal acupoints had a lower total incidence of adverse reactions (postoperative pain or soreness, local hematoma or ecchymosis, dizziness or vertigo, daytime drowsiness or lethargy, nausea or stomach upset, hypomnesia). Specifically, acupotomy-related adverse reactions in PI treatment mainly included postoperative local pain/soreness (21.05%) and hematoma/ecchymosis (15.79%), all of which

Table 6. Adverse event analysis

Adverse reactions	Control group (n=90)	Research group (n=95)	χ^2	P
Postoperative pain or soreness	1 (1.11)	20 (21.05)		
Local hematoma or ecchymosis	0 (0.00)	15 (15.79)		
Dizziness or vertigo	20 (22.22)	6 (6.32)		
Daytime drowsiness or lethargy	28 (31.11)	4 (4.21)		
Nausea or stomach upset	6 (6.67)	0 (0.00)		
Hypomnesia	4 (4.44)	0 (0.00)		
Total adverse reactions (≥1 events)	52 (57.78)	35 (36.84)	8.131	0.004

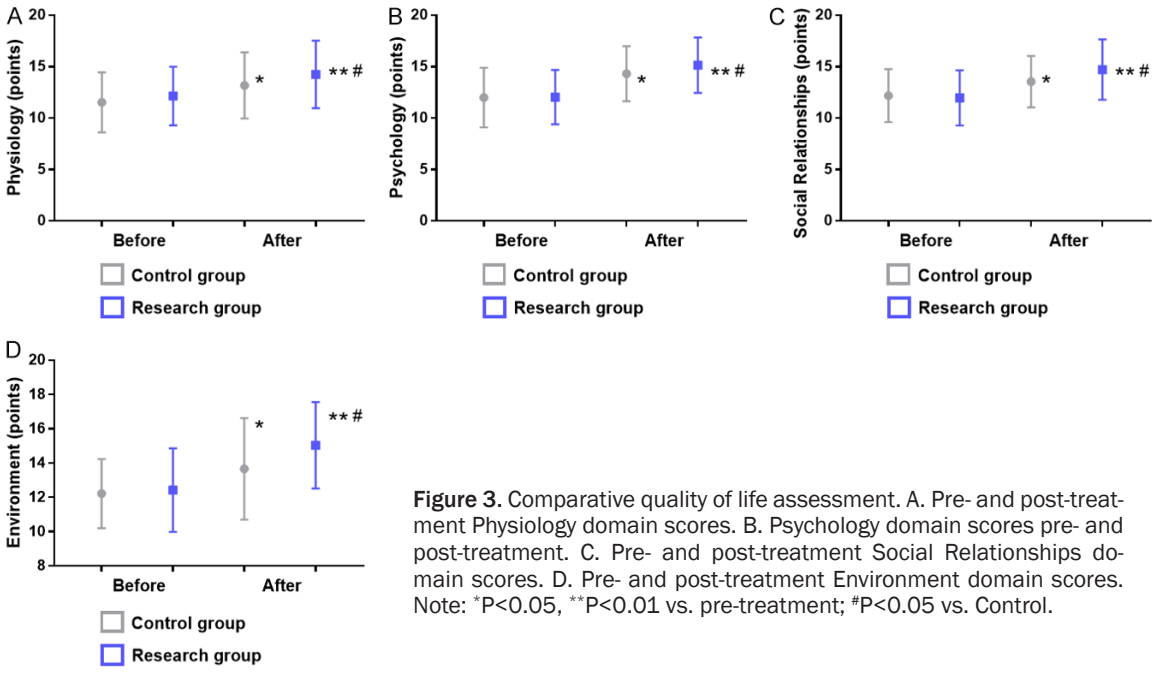

Figure 3. Comparative quality of life assessment. A. Pre- and post-treatment Physiology domain scores. B. Psychology domain scores pre- and post-treatment. C. Pre- and post-treatment Social Relationships domain scores. D. Pre- and post-treatment Environment domain scores. Note: *P<0.05, **P<0.01 vs. pre-treatment; #P<0.05 vs. Control.

were mild and self-limiting. However, it should be noted that the operation site involves the cervicothoracic junction and suboccipital triangle, areas with complex anatomical structures adjacent to the vertebral artery, spinal cord, and cupula pleurae. During the clinical popularization of acupotomy therapy, the following aspects need to be particularly emphasized: strict training of operators - exemplified by >3 years of clinical experience in acupotomy and ≥40 class hours of specialized training in the treatment of cervical diseases, as applied in this study - is a necessary condition; imaging should be performed before the procedure to exclude anatomical variations; the depth and direction of needle insertion (20-30 mm at the Fengchi acupoint and 20-25 mm at C7-T1 Jiaji acupoints) should be strictly controlled during the operation; it is also necessary to be vigilant about rare but serious complications such as needle breakage, pneumothorax, and vertebral artery injury. When promoting acupotomy in the future, it is recommended to perform the operation under ultrasound guidance to further enhance safety. Finally, QoL evaluation indicated a more pronounced improvement in QoL in PI patients receiving acupotomy at spinal acupoints. This is related to the effective improvement of sleep quality and the significant reduction of adverse mood in PI patients treated with acupotomy at spinal acupoints.

This study has several limitations that need to be gradually addressed. First, there is no sham acupotomy control group (e.g., performing skin disinfection alone without lysis and release), making it impossible to rule out the placebo effect. In the future, a well-designed sham acupotomy control should be adopted to effectively control the placebo effect and verify the spe-

cific effect of acupotomy treatment. Second, due to the lack of long-term follow-up data after treatment completion, improvements in sleep quality 3 months after treatment, or even 1 and 3 years post-treatment, remain unclear. Supplementing sufficient follow-up information can help clarify the durability of curative effects. Third, there is no subgroup analysis based on disease course. Patients with a long disease course may not respond well to acupotomy treatment, an issue that requires further verification in future supplementary research. Finally, there is no basic research exploring the mechanism of acupotomy at spinal acupoints, nor was there any detection of indices associated with sympathetic nervous system activity and cerebral blood flow velocity. Relevant analyses should be conducted to provide direct evidence for mechanism demonstration as much as possible.

In conclusion, acupotomy at spinal acupoints has a higher curative effect than Zolpidem Tartrate Tablets in the treatment of PI. It inhibits cortical arousal levels, improves sleep quality, prolongs sleep duration, relieves adverse mood, increases GA and GABA levels, reduces the total incidence of adverse reactions, and exerts a positive impact on patients' QoL.

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Disclosure of conflict of interest

None.

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