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Innovative Application and Efficacy Validation of Zhuang Medicine Hot-Compress Therapy in ERAS Nursing for Spinal Endoscope-Assisted ACDF

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Abstract

Objective: To investigate the clinical application and efficacy validation of Zhuang medicine hot-compress therapy in postoperative nursing care within an enhanced recovery after surgery (ERAS) framework for patients with cervical spondylotic myelopathy (CSM) undergoing spinal endoscope-assisted anterior cervical discectomy and fusion (ACDF). **Methods:** A retrospective observational study was conducted. A total of 68 patients with CSM who underwent endoscope-assisted ACDF at the Department of Minimally Invasive Spine Surgery, Yulin Orthopedic Hospital of Integrated Traditional Chinese and Western Medicine, from June 2023 to December 2024, were enrolled. Based on their informed and voluntary choice after receiving routine postoperative care, patients who additionally received Zhuang medicine hot-compress therapy were assigned to the observation group (n = 37), whereas those who received routine postoperative nursing alone were assigned to the control group (n = 31); no randomization was performed. The visual analogue scale (VAS) for neck pain and the Japanese Orthopaedic Association (JOA) scores were compared between the two groups preoperatively and at 1 week, 1 month, and 3 months postoperatively. Nursing satisfaction was also assessed at 1 week after surgery. **Results:** No significant differences were found in preoperative VAS or JOA scores between the two groups ($P > 0.05$). At 1 week post-intervention, the observation group had a significantly lower VAS score (2.0 ± 0.7) than the control group (3.3 ± 1.0) ($t = 6.18$, $P < 0.001$), and a significantly higher JOA score (14.3 ± 1.5) than the control group (12.9 ± 1.3) ($t = 4.12$, $P < 0.01$). Nursing satisfaction in the observation group was 94.6% (35/37), significantly higher than that in the control group (80.6%, 25/31) ($\chi^2 = 4.16$, $P < 0.05$). At 1-month follow-up, the observation group still showed significantly

better VAS (1.7 ± 0.6 vs. 2.4 ± 0.8, t = 4.05, P < 0.01) and JOA scores (15.2 ± 1.3 vs. 14.1 ± 1.2, t = 3.28, P < 0.01) compared with the control group. At 3 months postoperatively, there were no statistically significant differences between the two groups in VAS (1.4 ± 0.7 vs. 1.5 ± 0.8, t = 0.54, P > 0.05) or JOA scores (15.7 ± 1.1 vs. 15.6 ± 1.2, t = 0.35, P > 0.05). **Conclusion:** The application of Zhuang medicine hot-compress therapy in postoperative nursing within an ERAS nursing framework for endoscope-assisted ACDF in CSM patients can effectively relieve pain, improve cervical spinal function, and enhance patient satisfaction. This therapy demonstrates significant advantages in the early postoperative period (from 1 week to 1 month) and facilitates accelerated rehabilitation.

Keywords

Zhuang Medicine Hot-Compress Therapy, Endoscope, Cervical Spondylotic Myelopathy, Postoperative Nursing, Enhanced Recovery after Surgery

1. Introduction

CSM is a disease characterized by a series of neurological dysfunctions caused by spinal cord compression due to cervical spinal canal stenosis, which results from cervical disc herniation, posterior vertebral osteophyte formation, hypertrophy of the ligamentum flavum, ossification of the posterior longitudinal ligament, and other factors. With changes in people's lifestyle and the rapid development of technology, the incidence of this disease has been increasing year by year, and surgical treatment remains the preferred option [1]. As a classic procedure for CSM, ACDF offers advantages such as adequate decompression, high fusion rate, and good neurological recovery, and has become the gold standard for anterior cervical spine surgery. However, traditional open ACDF also has drawbacks, including significant surgical trauma, substantial intraoperative blood loss, severe soft tissue damage, pronounced postoperative pain, and prolonged recovery time [2] [3]. Endoscope assistance is a novel minimally invasive spinal technique that has emerged in recent years. By separating visualization from operative manipulation, this technique provides clear visualization, flexible maneuverability, and a relatively short learning curve [4]. It has demonstrated favorable clinical outcomes in ACDF procedures and has gradually become an important surgical option for treating CSM [5] [6].

In the field of spine surgery, enhanced recovery after surgery (ERAS) has emerged as an evidence-based, multidisciplinary perioperative pathway that integrates preoperative optimization, intraoperative precision, and postoperative rehabilitation to reduce surgical stress, alleviate pain, shorten hospital stay, and accelerate functional recovery. Recent peer-reviewed studies have confirmed that ERAS programs are safe and effective for patients undergoing anterior cervical discectomy and fusion (ACDF), including elderly populations, and that ERAS-guided rehabilitation nursing significantly improves postoperative recovery, pain control, and patient

satisfaction [7] [8]. In the present study, the postoperative nursing intervention was therefore implemented within an integrated ERAS framework, in which Zhuang medicine hot-compress therapy was delivered as an adjunct to standardized perioperative analgesic and rehabilitation measures.

Nevertheless, for CSM patients undergoing endoscope-assisted ACDF, postoperative nursing interventions are also of great significance in promoting early recovery and alleviating pain. However, Western nursing mainly focuses on disease-oriented care, which tends to be too monolithic to meet patients' demands for comprehensive care. Traditional Chinese medicine (TCM) has accumulated extensive experience, and its nursing protocols have been continuously refined, with proven clinical efficacy. In recent years, the Chinese government has placed great emphasis on the application of TCM in various medical fields, especially in preserving and leveraging the distinctive advantages of TCM, with substantial research and multiple initiatives undertaken [9] [10]. TCM emphasizes that "when vital qi is preserved within, pathogenic factors cannot interfere," and holds that spinal cord compression and blood stasis obstructing the collaterals are the fundamental pathogenesis leading to pain and dysfunction. The Treatise on Cold Damage and Synopsis of the Golden Chamber further elucidate that hot compresses can "warm the channels, disperse cold, activate blood, and resolve stasis," and have significant therapeutic effects on pain and swelling caused by blood stasis. As an important component of Zhuang traditional medicine, Zhuang medicine hot-compress therapy achieves the effects of activating blood circulation, removing stasis, unblocking collaterals, reducing swelling, and alleviating pain through medicated hot application [11] [12]. This therapy is widely used in clinical practice in the Guangxi region and has demonstrated good safety and efficacy [13]. However, its mechanism of action and clinical efficacy in postoperative recovery of this patient population still lack sufficient evidence-based medical support. Therefore, the present study aims to evaluate the clinical effectiveness of Zhuang medicine hot-compress therapy in postoperative nursing care for CSM patients undergoing endoscope-assisted ACDF through a retrospective observational analysis, so as to provide a scientific basis for optimizing integrated TCM-Western medicine nursing protocols. The report is as follows.

2. Materials and Methods

2.1. General Data

Patients were allocated to the observation or control group retrospectively according to the postoperative nursing intervention they actually received. During the study period, Zhuang medicine hot-compress therapy was offered as an adjunctive nursing intervention after routine postoperative care, and the decision to receive the therapy was made based on patients' preferences after they had been informed of the treatment procedure. Patients who received Zhuang medicine hot-compress therapy in addition to routine postoperative nursing were classified into the observation group (n = 37), whereas those who received routine postoperative nursing

alone were classified into the control group (n = 31). No random allocation was performed. To reduce potential selection bias, the same predefined inclusion and exclusion criteria were applied to both groups, and baseline demographic and clinical characteristics were compared between the groups to assess comparability. Because this was a retrospective observational design in which treatment allocation was not controlled by the investigators but was determined by patients' informed voluntary choice in routine clinical practice, we acknowledge that residual selection bias and confounding cannot be fully excluded. To mitigate this, the eligibility criteria and perioperative cointerventions were standardized across both groups and baseline comparability was verified statistically, in keeping with recommended approaches for the analysis of non-randomized studies [14].

A total of 68 patients with CSM who were hospitalized in the Department of Minimally Invasive Spine Surgery at Yulin Orthopedic Hospital of Integrated Traditional Chinese and Western Medicine from June 2023 to December 2024 were enrolled. Inclusion criteria: ① Diagnosed with CSM according to the diagnostic criteria for cervical spondylosis from the Chinese Journal of Surgery [15], with imaging (MRI/CT) confirmation that the involved segment was suitable for ACDF; ② Aged 18 - 75 years; ③ Failed conservative treatment or recurrent symptoms, with clear indications for endoscope-assisted ACDF; ④ Complete postoperative follow-up clinical data available; ⑤ Patients and their families provided informed consent and voluntarily participated in this study. Exclusion criteria: ① Concurrent severe dysfunction of vital organs such as heart, liver, or kidneys; ② Previous history of cervical spine surgery; ③ Concurrent cervical deformity, tumors, severe osteoporosis, ankylosing spondylitis, rheumatoid arthritis, or other diseases; ④ Psychiatric disorders or cognitive impairment that prevented cooperation with treatment and evaluation; ⑤ Pregnancy or lactation; ⑥ Allergy to Zhuang medicine hot-compress therapy or skin lesions at the application site; ⑦ Withdrawal from the study or loss to follow-up. This study was approved by the Medical Ethics Committee of Yulin Orthopedic Hospital of Integrated Traditional Chinese and Western Medicine (ethics approval number: 202506001). There were no statistically significant differences in general data such as sex, age, disease duration, and involved segments between the two groups ($P > 0.05$), indicating comparability (see Table 1).

Table 1. Comparison of general data between the two groups.

Group	Control group	Observation group	Test statistic	P-value
Number of cases	31	37	-	-
Sex (Male/Female)	16/15	18/19	$\chi^2 = 0.089$	>0.05
Age (years)	51.8 ± 9.2	52.4 ± 8.6	t = 0.289	>0.05
Disease duration (months)	19.4 ± 13.1	18.7 ± 12.3	t = 0.235	>0.05
Involved segments (C4/5, C5/6, C6/7)	9/15/7	10/18/9	$\chi^2 = 0.127$	>0.05

Follow-up and missing data

All patients included in the final analysis had complete clinical follow-up data at 1 week, 1 month, and 3 months postoperatively. Patients who were lost to follow-up or had incomplete outcome data at any of the prespecified follow-up time points were excluded according to the predefined eligibility criteria. Therefore, no missing outcome data were present in the final dataset, and no imputation method was required.

2.2. Methods

To minimize the potential influence of perioperative cointerventions on pain and functional outcomes, both groups received the same standardized postoperative analgesic and rehabilitation protocols. Postoperative analgesia was administered according to the same institutional protocol in both groups. Rehabilitation training was also standardized between the two groups. Under the guidance of the same nursing and rehabilitation team, patients were instructed to perform active limb exercises, isometric cervical muscle contractions, and shoulder range-of-motion exercises, together with standardized early mobilization and ambulation training. The timing, frequency, and intensity of rehabilitation were consistent between the two groups and were adjusted only when clinically necessary according to individual tolerance. Apart from the additional Zhuang medicine hot-compress therapy administered to the observation group, the routine postoperative treatment, analgesic management, and rehabilitation nursing protocols were identical between the two groups. Specifically, the perioperative ERAS measures applied identically to both groups comprised: 1) standardized multimodal postoperative analgesia according to the institutional protocol; 2) early mobilization and graded ambulation under cervical collar protection; 3) structured rehabilitation training, including active limb exercises, isometric cervical muscle contractions, and shoulder range-of-motion exercises; 4) early dietary progression and incision care; and 5) patient education on activity precautions and cervical protection. These ERAS components were delivered by the same nursing and rehabilitation team, with identical timing, frequency, and intensity across both groups.

Both groups of patients underwent endoscope-assisted ACDF performed by the same surgical team and received routine symptomatic treatment postoperatively, including prophylactic antibiotics, dehydrating agents, and analgesics as necessary.

2.2.1. Control Group

Routine postoperative nursing care was provided, including: ① Wearing a cervical collar for 4 - 6 weeks, with the neck maintained in a neutral position and avoidance of excessive flexion, extension, and rotation; ② Keeping the dressing clean and dry, and closely monitoring the incision for bleeding, exudation, or signs of infection; ③ Early guidance on activities, teaching patients proper log-rolling techniques and safe ambulation, and avoiding activities that increase cervical loading such as heavy lifting; ④ Gradually guiding patients to perform active limb exercises, isometric cervical muscle contractions, and shoulder range-of-motion exercises as part of rehabilitation training.

2.2.2. Observation Group

On the basis of the control group, the observation group received Zhuang medicine hot-compress therapy, twice daily, 20 - 30 minutes each session, for 7 consecutive days. The specific method was as follows: Twelve herbal ingredients—Daluoshan 11 g, Xiaoluoshan 11 g, Liangmianzhen 11 g, Ezhu 7 g, Honghua 5 g, Yingbupu 11 g, Chuanposhi 11 g, Zoumatai 11 g, Huzhang 11 g, Wuyao 5 g, Jiulongchuan 3 g, and Zelan 7 g—were crushed into coarse powder, soaked in medicated wine for bruising (dieda jiu), packed in cloth bags, and steamed for 30 minutes. The hot-compress therapy was then applied to the affected area by nursing staff trained in traditional Chinese physiotherapy, with the temperature controlled at 45˚C - 50˚C and adjusted to the patient's comfort level.

2.3. Outcome Measures

2.3.1. Nursing Satisfaction

Nursing satisfaction was assessed at 7 days postoperatively using the Chinese-language version of the Newcastle Satisfaction with Nursing Scale (NSNS) [16]. The questionnaire was administered by a trained nurse who was not directly involved in the patients' routine postoperative nursing care. Before completion, standardized instructions regarding the purpose and response method of the questionnaire were provided. Patients completed the questionnaire independently whenever possible, and assistance with reading or item clarification was provided when necessary without influencing their responses.

The NSNS consists of 19 items scored on a 5-point Likert scale, yielding a total score ranging from 19 to 95, with higher scores indicating greater satisfaction with nursing care. In the present study, scores < 70, 70 - 85, and ≥86 were categorized as "dissatisfied," "satisfied," and "very satisfied," respectively. These categories were used as prespecified operational thresholds for descriptive analysis in this study rather than as established diagnostic cutoffs of the original NSNS. Overall satisfaction was calculated as follows: (number of "satisfied" + number of "very satisfied" patients)/total number of patients × 100%.

2.3.2. Pain Severity

VAS is a classic tool for subjective pain assessment, widely used in pain research both domestically and internationally, with good reliability and validity [17]. VAS scores were used to evaluate pain severity preoperatively and at 1 week, 1 month, and 3 months postoperatively. The scale ranges from 0 to 10, with 0 indicating no pain and 10 indicating intolerable severe pain; higher scores indicate worse pain. Baseline preoperative values and postoperative scores at the three time points were recorded.

2.3.3. Cervical Functional Recovery

JOA is a common tool for evaluating functional status in cervical spondylosis, and its reliability and validity have been validated in numerous studies [18]. JOA scores were used to assess cervical function preoperatively and at 1 week, 1 month, and

3 months postoperatively. The assessment includes subjective symptoms, clinical signs, and limitations in daily living activities, with a total score ranging from 0 to 17; higher scores indicate better cervical function.

2.4. Statistical Analysis

Statistical analyses were performed using SPSS 26.0 software. For continuous variables (VAS and JOA scores) that followed a normal distribution, independent-sample t-tests were used to compare postoperative differences between the two groups, and paired t-tests were used for within-group comparisons before and after surgery. Categorical variables (nursing satisfaction) were analyzed using the χ^2 test. The significance level was set at two-sided $\alpha = 0.05$, and $P < 0.05$ was considered statistically significant. Results are presented as mean ± standard deviation (Mean ± SD) or as proportions.

3. Results

3.1. Comparison of Nursing Satisfaction between the Two Groups (See Table 2)

Table 2. Comparison of nursing satisfaction between the two groups.

Group	Control group	Observation group	P-value
Number of cases	31	37	-
Very satisfied	10 (32.3)	24 (64.9)	
Satisfied	15 (48.4)	11 (29.7)	
Dissatisfied	6 (19.3)	2 (5.4)	
Overall satisfaction	25 (80.6)	35 (94.6)	< 0.05

3.2. Comparison of VAS and JOA Scores between the Two Groups at Preoperative and Various Postoperative Time Points (See Table 3)

Table 3. Comparison of VAS and JOA scores between the two groups (Mean ± SD, scores).

Group	Number of cases	VAS score				JOA score			
		Preoperative	1 week	1 month	3 months	Preoperative	1 week	1 month	3 months
Observation group	37	6.2 ± 1.1	2.0 ± 0.7[a]	1.7 ± 0.6[b]	1.4 ± 0.7	9.5 ± 1.2	14.3 ± 1.5[a]	15.2 ± 1.3[b]	15.7 ± 1.1
Control group	31	6.4 ± 1.2	3.3 ± 1.0	2.4 ± 0.8	1.5 ± 0.8	9.7 ± 1.1	12.9 ± 1.3	14.1 ± 1.2	15.6 ± 1.2
t		0.72	6.18	4.05	0.54	0.69	4.12	3.28	0.35
P		0.475	<0.001	<0.01	0.593	0.494	<0.01	<0.01	0.728

4. Discussion

In this retrospective observational study, we investigated the effects of Zhuang medicine hot-compress therapy as an adjunct to postoperative nursing care in pa-

tients with cervical spondylotic myelopathy (CSM) undergoing endoscope-assisted anterior cervical discectomy and fusion (ACDF). The results showed that, compared with routine nursing care alone, the addition of Zhuang medicine hot-compress therapy significantly reduced postoperative pain, as indicated by lower VAS, improved cervical neurological function, as reflected by higher JOA, and increased nursing satisfaction during the early postoperative period (from 1 week to 1 month). However, by 3 months after surgery, the clinical outcomes were comparable between the two groups.

As a common disease in spinal surgery, postoperative pain management and functional rehabilitation of CSM have always been clinical priorities [19]. Although endoscope-assisted ACDF offers advantages such as minimally invasiveness and faster recovery, effective nursing interventions are still required for postoperative pain control and functional restoration. Conventional postoperative nursing can ensure basic safety but has certain limitations in pain relief and functional improvement [20]. As an important component of Zhuang traditional medicine, Zhuang medicine hot-compress therapy is based on the Zhuang medical theory of the "Three Passages and Two Pathways" (the Grain Passage, Water Passage, and Air Passage; and the Dragon Pathway and Fire Pathway), which holds that diseases are caused by pathogenic factors such as "Sha, Zhang, Gu, Du, Wind, and Dampness" invading the body, obstructing the "Two Pathways," and disrupting the synchronized balance of the three qi (Heaven, Human, and Earth). Through the medicated hot application, this therapy exerts synergistic "medicinal and thermal" effects on specific body surface areas to unblock the Dragon and Fire Pathways, regulate the balance of the three qi, and thereby dispel wind and dampness toxins, reduce swelling, and alleviate pain [12]. The findings of this study demonstrate that Zhuang medicine hot-compress therapy exhibits significant advantages in early rehabilitation following endoscope-assisted ACDF. At 1 week and 1 month postoperatively, the observation group had significantly lower VAS scores than the control group (2.0 ± 0.7 vs. 3.3 ± 1.0 and 1.7 ± 0.6 vs. 2.4 ± 0.8, respectively; both $P < 0.01$). The observation group also had significantly higher JOA scores than the control group at 1 week (14.3 ± 1.5 vs. 12.9 ± 1.3, $P < 0.01$) and 1 month (15.2 ± 1.3 vs. 14.1 ± 1.2, $P < 0.01$) postoperatively. At 3 months, no significant between-group differences were observed in either VAS or JOA scores (both $P > 0.05$). In a study by Li Yi *et al.*, 82 patients with cervical spondylosis were randomly divided into a control group ($n = 41$) receiving routine rehabilitation nursing and an observation group ($n = 41$) receiving Chinese herbal hot-compress rehabilitation nursing in addition to routine care. The results showed that after nursing intervention, the VAS scores and cervical dysfunction index scores of the observation group were significantly lower than those of the control group ($P < 0.05$) [21]. Similar conclusions were also drawn by Huang Lanyi *et al.* in their study on channel-based Chinese herbal hot-compress therapy for patients with cervical radiculopathy [22]. The mechanisms of Zhuang medicine hot-compress therapy may involve multiple aspects. First, the thermal effect promotes local blood circu-

lation, accelerates the clearance of inflammatory cytokines, and reduces tissue edema, thereby alleviating pain [23] [24]. Second, the blood-activating and stasis-resolving herbal components such as Liangmianzhen and Honghua can improve microcirculation and promote tissue repair [25] [26]; herbs such as Daluoshan and Xiaoluoshan possess detumescent and bone-knitting properties that can reduce local postoperative inflammation [27] [28]; and herbs such as Zoumatai have effects in strengthening tendons and bones and dispelling wind-dampness, which help improve cervical muscle function, collectively contributing to overall functional recovery [29] [30]. Of note, at the 3-month follow-up, the differences between the two groups tended to disappear. This phenomenon may be attributed to the following factors: first, with prolonged postoperative time, surgical trauma gradually heals and the inflammatory response naturally subsides; second, Zhuang medicine hot-compress therapy primarily acts on early-stage inflammation and pain control, with a relatively limited impact on long-term functional recovery; third, at 3 months postoperatively, patients have entered the bony fusion phase, where the main determinant of functional recovery is the quality of bony union rather than early-stage inflammation. This finding further suggests that the primary value of Zhuang medicine hot-compress therapy lies in accelerating the early rehabilitation process rather than altering long-term outcomes.

In terms of nursing satisfaction, the overall satisfaction rate in the observation group reached 94.6%, significantly higher than that in the control group (80.6%, $P < 0.05$). This result reflects that Zhuang medicine hot-compress therapy not only achieved favorable outcomes in objective indicators but also gained patient recognition in subjective experience. This may be related to the following factors: the application procedure is gentle and comfortable, making it well-accepted by patients; the significant pain relief and functional improvement enhance patients' confidence in treatment; and the TCM-characterized nursing embodies personalization and humanistic care, improving the overall nursing experience.

From the perspective of integrated traditional Chinese and Western medicine, this study demonstrates an organic combination of traditional and modern medicine. Endoscope-assisted ACDF addresses the fundamental problem of spinal cord compression, while Zhuang medicine hot-compress therapy promotes postoperative rehabilitation at both systemic and local levels. The two approaches complement each other, achieving a synergistic effect of "1 + 1 > 2". This combined model not only ensures the precision and safety of modern medicine but also leverages the holistic regulatory and natural healing advantages of traditional medicine.

The Zhuang medicine hot-compress protocol used in this study has good clinical practicality. The herbal medicines used are all commonly used Chinese herbs in the Zhuang region, with abundant sources and relatively low cost. The operation method is simple and easy to master by trained nursing staff. The treatment process is safe and non-invasive, with good patient compliance. These characteristics make this protocol worthy of clinical promotion, particularly with promising

application prospects in medical institutions in Guangxi and surrounding areas.

However, this study has certain limitations. First, the sample size is relatively small and the study duration is short, requiring further observation of long-term effects. Second, as a single-center study, the generalizability of the findings needs to be validated by multicenter studies. Third, the specific mechanisms of Zhuang medicine hot-compress therapy require more in-depth basic research for elucidation. Finally, cost-effectiveness analysis and the development of standardized operating procedures are also aspects that need to be refined in the future. In addition, because this was a retrospective observational study without randomization, residual selection bias and unmeasured confounding cannot be fully excluded, and the causal interpretation of the observed associations should be made with caution; these aspects will be addressed in future prospective randomized trials.

5. Conclusion

In summary, Zhuang medicine hot-compress therapy in postoperative nursing within an ERAS nursing framework for CSM patients undergoing endoscope-assisted ACDF can significantly reduce pain, improve cervical function, and enhance patient satisfaction in the early postoperative period (from 1 week to 1 month). As recovery progresses naturally, the therapeutic effects between the two groups converge at 3 months, suggesting that the primary value of this intervention lies in accelerating early rehabilitation. Based on the preliminary evidence from this study, Zhuang medicine hot-compress therapy, as a safe, low-cost, and easy-to-administer TCM-characterized nursing modality, warrants further validation in larger-scale, multicenter clinical studies, and exploration of its potential application in comprehensive rehabilitation protocols.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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