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Original Research Article

Effect of mecobalamin dispersible tablets and surgical treatment on nerve conduction velocity and skin sympathetic reflex in cervical spondylotic radiculopathy patients

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Abstract

Purpose: *To investigate the effect of mecobalamin dispersible tablets and surgical treatment on nerve conduction velocity and skin sympathetic reflex in patients with cervical spondylotic radiculopathy (CSR).*

Methods: *82 patients diagnosed with CSR between February 2019 and January 2022 in Inner Mongolia Medical University School of Basic Medicine, Hohhot City, China were randomized into control and study groups comprising 41 patients each. The control group was treated with anterior cervical diskectomy and fusion, while the study group was treated with mecobalamin dispersible tablets in addition to surgery. Efficacy was assessed 3 months after surgery.*

Results: *Efficacy in the study group was significantly higher than in the control group ($p < 0.05$). Furthermore, the study group had significantly greater motor and sensory nerve conduction velocity of the median and ulnar nerve as well as reduced initial wave latency ($p < 0.05$). Scores of subjective symptoms, clinical signs, and life-work-social adaptability were significantly higher in the study group than in the control group ($p < 0.05$). Range of motion of the neck significantly improved and brain-derived neurotrophic factor and glial neurotrophic factor were significantly increased in the study group compared to control group ($p < 0.05$).*

Conclusion: *Mecobalamin dispersible tablets in combination with surgery improve nerve conduction velocity, skin sympathetic reflex function, neurotrophic factor level, cervical motion, and cervical spine function in patients with CSR. Multicenter long-term controlled studies with larger sample sizes are required in future studies.*

Keywords: *Cervical spondylotic radiculopathy, Mecobalamin dispersible tablets, Anterior cervical discectomy, Fusion, Nerve conduction velocity, Skin sympathetic reflex*

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INTRODUCTION

Cervical spondylotic radiculopathy (CSR) is caused by irritation or compression of unilateral or bilateral spinal nerve roots and manifests itself as motor, sensory, and reflex deficits. Patients

present with neck, shoulder, back, and radiation pain, numbness, weakness and other symptoms of upper limbs and fingers [1]. Anterior cervical diskectomy and fusion (ACDF) is recommended for patients who have failed non-surgical treatment, and it improves clinical symptoms and cervical function of patients [2].

Combined drug therapy based on surgical treatment effectively improves clinical efficacy and prognosis of patients [3]. Mecobalamin, a cobalt-containing vitamin B12, exhibits a high affinity towards nerve tissues [4]. Previous studies have indicated that mecobalamin facilitates nucleic acid metabolism via methyl conversion reactions, contributes to thymine synthesis, supports axonal regeneration, and myelin sheath formation, and aids in the repair of damaged nerve tissues [5].

This study was aimed at investigating the impact of mecobalamin dispersible tablets in conjunction with surgical intervention on nerve conduction velocity and skin sympathetic reflex in patients with CSR. Additionally, this study aimed to investigate the underlying mechanism of CSR, thereby offering valuable insights for clinical management.

METHODS

Patient data

A total of 82 patients diagnosed in Inner Mongolia Medical University School of Basic Medicine, Hohhot City, China with CSR between February 2019 and January 2022 were randomly grouped into study and control groups comprising of 41 patients each. Clinical data showed no significant difference between the two groups ($p > 0.05$; Table 1). This study was approved by the ethics committee of Inner Mongolia Medical University School of Basic Medicine, Hohhot City (approval no. 201810M33), and met the criteria in the Declaration of Helsinki [6].

Inclusion criteria

Patients who met the diagnostic criteria [7], and signed the informed consent.

Exclusion criteria

Patients with intraspinal tumours and thoracolumbar diseases, peripheral nerve injury, patients with previous cervical spine surgery, patients with spinal cord or vertebral artery injury, other surgical complications, and patients with other cervical diseases.

Treatment

Control group

Anterior cervical diskectomy and fusion (ACDF) was performed under general anesthesia. A horizontal incision was made to expose the operative field. A vertebral screw was inserted into the upper and lower vertebral bodies adjacent to the diseased intervertebral space which was later resected. The intervertebral space was moderately extended with the deep vertebral spinner, and height of the normal intervertebral space was restored and maintained with the Caspar spinner. Posterior vertebral osteophytes and degenerative intervertebral disc protruding into the spinal canal were carefully removed with gun-typing bone cutting forceps, and uncovertebral joint was reached on both sides. The extended bone resection was continued in the direction of the nerve root canal. Lateral disc protrusion was carefully removed until the compressed nerve root was fully dissociated. After thorough decompression, the cartilage endplate was scraped off with a curet until the bone surfaced leaked blood. Attention was paid to preserving the upper and lower osseous endplates of the intervertebral disc. Cage test molds consistent with the height and shape of the intervertebral disc were placed into the intervertebral space. Titanium plates of appropriate length were fixed

Table 1: Clinical Data between the two groups (n = 41)

Group	Gender		Age (years)	Course of disease (years)	Diseased segment		
	Male	Female			C4~5	C5~6	C6~7
Study	23	18	48.03±3.07	2.95±0.41	20	13	8
Control	25	16	47.92±3.15	3.06±0.45	17	15	9
χ^2/t	0.201		0.1601	1.157		0.445	
P-value	0.654		0.873	0.251		0.801	

in front of the vertebral body after proper pre-bending. Two single cortical screws were used to fix each vertebral body, and the titanium plates were locked with screws. After incision cleaning and subcutaneous tissue and skin sutures, antibiotics were routinely used after surgery. Incision drainage plates were removed on day 1, anteroposterior and lateral X-rays of the cervical spine were reviewed on day 2 after surgery, and patients worn the neck brace to move on the ground on day 3 after surgery for 8 weeks.

Study group

The study group was treated with mecobalamin (Yabao Pharmaceutical Group Co., Ltd, H20041767) at 500 μg/L (3 times/day, for 2 weeks) in combination with the treatment for the control group.

Evaluation of parameters/indices

Efficacy

Macnab efficacy evaluation criterion was used to evaluate clinical efficacy [8]. The criterion was classified as excellent (symptoms abated entirely, resulting in full restoration of original functioning level in both work and personal life), good (symptoms showed significant improvement, with some minor limitations in activity but no discernible impact on work or daily activities), fair (symptoms were alleviated to some extent, with noticeable limitations in activity that affected the ability to perform normal work and daily tasks), poor (no improvement or even worsening of clinical symptoms was observed).

Motor and sensory nerve conduction velocities

Motor and sensory nerve conduction velocities (MCV and SCV) of the median and ulnar nerves, as well as initial wave latency and main wave amplitude, were assessed using key-point electromyography before and 3 months after surgery. Also, the Clinical Assessment Scale for Cervical Spondylosis (CASCS) was evaluated [9], including subjective symptoms (18 points), clinical signs (73 points), and life-work-society adaptability (9 points) 3 months after surgery. Higher scores indicate better clinical improvement for patients. Furthermore, cervical flexion, extension, lateral flexion, and rotation were measured using a helmet-type cervical range-of-motion measuring instrument. Glial cell line-derived neurotrophic factor (GDNF) and brain-derived neurotrophic factor (BDNF) before and 2 weeks after surgery were measured using ELISA kits (MLBIO company, Shanghai, China).

Postoperative complications

Incidence of postoperative complications such as decreased nerve root innervation muscle strength and postoperative hematoma were calculated.

Statistical analysis

Data were analyzed using Statistical Packages for Social Sciences (SPSS version 20.0 Co., Ltd., Chicago, USA). Count data were presented in frequency and percentages and compared using χ^2 test. Measurement data were presented in mean ± standard deviation (SD) and compared using t-test. $P < 0.05$ was considered statistically significant.

RESULTS

Clinical efficacy

Study group exhibited significantly greater clinical efficacy compared to control group ($p < 0.05$; Table 2).

Motor and sensory nerve conduction velocities (MCV and SCV)

There was no significant difference in preoperative nerve conduction velocity between study and control groups ($p > 0.05$; Figure 1). However, study group had significantly higher MCV (Figure 1 A) and SCV (Figure 1 C) compared to control group ($p < 0.05$).

Skin sympathetic reflex

There was no significant difference in initial wave latency (Figure 2 A) and main wave amplitude (Figure 2 B) between study and control groups before surgery ($p > 0.05$). However, study group

Table 2: Clinical efficacy (n = 41 in each group)

Group	Excellent	Good	Fair	Poor	Total effective rate
Study	15	20	4	2	95.12
Control	9	13	10	9	78.05
χ^2					5.145
P-value					0.023

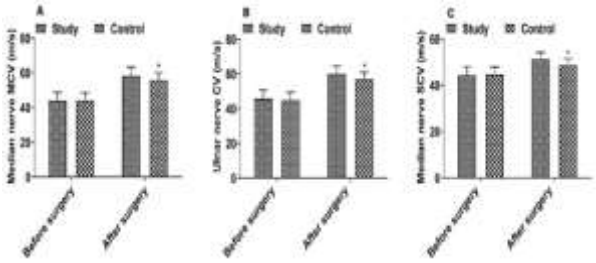

Figure 1: Nerve conduction velocity for study and control groups. *P < 0.05 vs study group after surgery

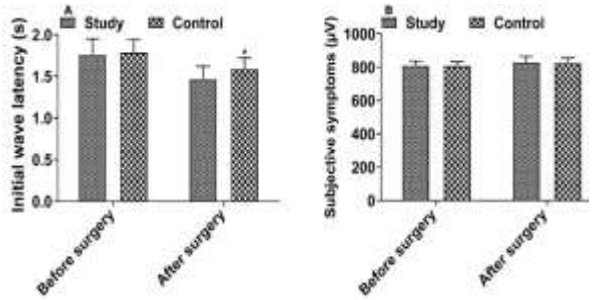

Figure 2: Skin sympathetic reflex for study and control groups. *P < 0.05 vs study group after surgery

exhibited significantly shorter initial wave latency after surgery compared to control group (p < 0.05).

Cervical spine function

There was no significant difference in CASCS scores between study and control groups (p > 0.05; Figure 3) before surgery. However, study group showed significantly higher subjective symptoms (Figure 3 A), clinical signs (Figure 3 B), and life-work-society adaptability (Figure 3 C) after surgery compared to control group (p < 0.05).

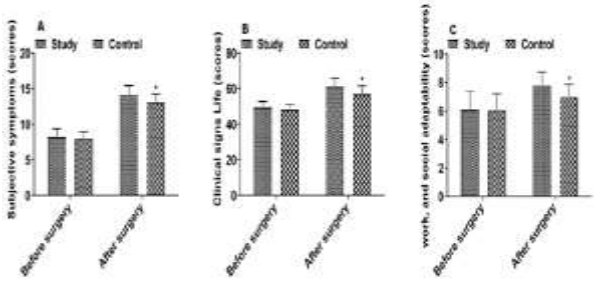

Figure 3: The CASCS scores for study and control groups. *P < 0.05 vs study group after surgery

Cervical motion

There was no significant difference in cervical motions between study and control groups before surgery (p > 0.05; Figure 4). However, study group showed significantly higher cervical flexion (Figure 4 A), extension (Figure 4 B), lateral flexion (Figure 4 C), and rotation angles (Figure 4 D, E, F) after surgery compared to control group (p < 0.05).

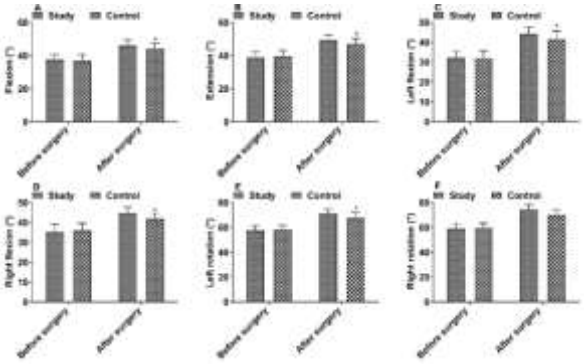

Figure 4: Cervical motion in study and control groups. *P < 0.05 vs study group after surgery

Neurotrophic factor levels

There was no significant difference in BDNF and GDNF levels before surgery between study and control groups (p > 0.05). However, study group exhibited significantly higher BDNF (Figure 5 A) and GDNF (Figure 5 B) levels after surgery compared to control group (p < 0.05).

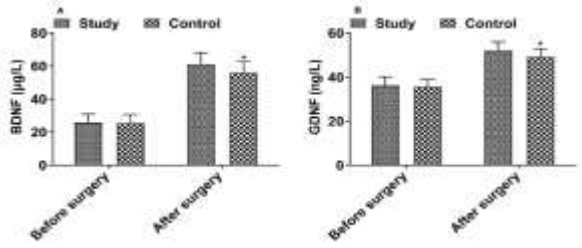

Figure 5: Comparison of BDNF and GDNF levels. *P < 0.05 compared to study group after surgery

Postoperative complications

Control group had 1 case of decreased nerve root innervation muscle strength at the surgical level, and study group had 1 case of postoperative hematoma. Both groups did not experience significant differences in postoperative complications (p > 0.05).

DISCUSSION

Frequent use of the Internet and electronic products has led to an increase in neck flexion among young and middle-aged people, resulting in an increase in cervical spondylosis prevalence. Cervical spondylotic radiculopathy (CSR) is one of the most common types of cervical spondylosis in clinical practice [10]. Most

patients obtain excellent curative effects after conservative treatment, and some still need surgical treatment. Anterior cervical diskectomy and fusion (ACDF) is a common surgical procedure in CSR, which effectively reduces nerve compression and improves clinical symptoms, but some patients still have poor prognosis. Combining surgical and Western medical treatment improves clinical outcomes [11].

Mecobalamin is a coenzyme vitamin B12, which is directly involved in the metabolism of homocysteine and is taken up by neuronal sub-organs, thus effectively ameliorating neurological disorders [12]. It has been reported that mecobalamin has therapeutic effects on patients with peripheral nerve diseases [13]. Thus, this study investigated the effect of mecobalamin in combination with surgical treatment in patients with cervical spondylotic radiculopathy. This study revealed that mecobalamin in combination with surgical treatment resulted in higher CASCS scores for subjective symptoms, clinical signs, and life-work-society adaptability after surgery. Additionally, mecobalamin and surgical treatment demonstrated greater postoperative cervical range of motion compared to control group. These findings suggest that the combination of mecobalamin dispersed tablets with surgery may enhance cervical spine function in patients with CSR. Enhancement of cervical spine range of motion by mecobalamin is primarily attributed to stimulation of protein and nucleic acid production in nerve cells, facilitation of myelin lecithin synthesis, and acceleration of repair processes following peripheral nerve injury, ultimately facilitating functional recovery in patients. In addition, mecobalamin improves circulation in the affected area, reduces edema, enhances local cell metabolism, and also improves cervical spine function in patients [14].

Cervical spondylotic radiculopathy is a painful disease caused by stimulation and compression of nerve roots in the spinal canal or foramina due to lateral and posterior herniation of the cervical disc or degenerative hyperplasia of the cervical joint. Mecobalamin accelerates repair of injured nerves and relieves symptoms of numbness and pain [15]. This study demonstrated that mecobalamin in combination with surgical treatment increased the MCV and SCV of the median and ulnar nerve and shortened the initial wave latency. These results suggest that the combination of mecobalamin dispersible tablets with surgery may enhance nerve conduction velocity and skin sympathetic reflex function. This improvement caused by mecobalamin is likely attributed to involvement in nucleic acid, protein, and lecithin synthesis, as well as promotion of nerve myelination and axon regeneration [16]. Nerve roots are sensitive to mechanical compression, which causes anoxic state and affects neurotrophic function [17]. Clinicians have used mecobalamin to treat some nutritional and other diseases [18,19]. As a neuroprotectant, it promotes regeneration of injured nerves and blocks neurotoxic effects of glutamate [20,21]. Also, results of this study revealed that mecobalamin in combination with surgical treatment enhanced postoperative BDNF and GDNF levels. This suggests that the synergistic effect of the combined treatment demonstrated a neurotrophic role by enhancing levels of neurotrophic factors, particularly attributed to the neuroprotective properties of mecobalamin. This mechanism involves promotion of nerve regeneration and the mitigation of glutamate-induced neurotoxicity. In addition, there was a decrease in operative nerve root innervation muscle strength (1 case) in control group and postoperative hematoma (1 case) in study group. The incidence of post-surgery complications was similar across both groups, indicating that mecobalamin in combination with surgery did not enhance post-surgery complication rates, implying a high safety profile.

Limitations of this study

This study has some limitations. There were no subgroup comparisons, no long-term follow-up results, or reports on the mechanism associated with this combination treatment in this single-center study.

CONCLUSION

Mecobalamin dispersible tablets in combination with surgical treatment increase nerve conduction velocity, improve cutaneous sympathetic reflexes, increase levels of neurotrophic factors, and improve cervical spine motion and function in CSR patients. Multicenter long-term controlled studies with larger sample sizes are required in future investigation.

DECLARATIONS

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Ethical approval

None provided.

Availability of data and materials

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

Conflict of Interest

No conflict of interest associated with this work.

Contribution of Authors

We declare that this work was done by the authors named in this article, and all liabilities pertaining to claims relating to the content of this article will be borne by the authors. YouWei Guo, WeiMing Xu, Gang Liu and EnHeJiRiGaLa conceived and designed the study, and drafted the manuscript. Bin Liu, Shuai Xu, Wei Wang and XingDa Guo collected, analyzed and interpreted the experimental data. XingDa Guo, Gang Liu and EnHeJiRiGaLa revised the manuscript for important intellectual content. All authors read and approved the final manuscript.

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REFERENCES

1. *Lin T, Wang Z, Chen G, Liu W. Predictive effect of cervical sagittal parameters on conservative treatment of single-segment cervical spondylotic radiculopathy. World Neurosurg 2020; 134: e1028-e1036.*
2. *Ramos MRD, Mendoza CJP, Yumol JV, Joson RS, Ver MLP, Ver MR. Multilevel, percutaneous posterior cervical interfacet distraction and fusion for cervical spondylotic radiculopathy. Spine 2021; 46: E1146-E1154.*
3. *Li J, Chen Y. Anticancer activity of isomultiflorenol against human cervical cancer cells due to G2/M cell cycle arrest, autophagy and mitochondrial-mediated apoptosis. Trop J Pharm Res 2020; 19: 1423-1428.*
4. *Scalabrino G, Peracchi M. New insights into the pathophysiology of cobalamin deficiency. Trends Mol Med 2006; 12(6): 247-254.*
5. *Goel A, Dandpat S, Shah A, Rai S, Vutha R. Muscle weakness-related spinal instability is the cause of cervical spinal degeneration and spinal stabilization is the treatment: an experience with 215 cases surgically treated over 7 years. World Neurosurg 2020; 140: 614-621.*
6. *World Medical Association. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. JAMA 2013; 310: 2191-2194.*
7. *Lawless MH, Tong D, Claus CF, Hanson C, Li C, Park P, Chang VW, Abdulhak MM, Houseman CM, Bono PL, et al. Preoperative symptom duration as a predictor for patient-reported outcomes in anterior cervical discectomy and fusion in non-myelopathic patients: Analysis from the Michigan Spine Surgery Improvement Collaborative (MSSIC). Neurosurg 2020; 86: 9-12.*
8. *Tumialán LM, Ponton RP, Cooper AN, Gluf WM, Tomlin JM. Rate of return to military active duty after single and 2-level anterior cervical discectomy and fusion: A 4-year retrospective review. Neurosurg 2019; 85: 96-104.*
9. *Sumikawa M, Yano T, Mizutani M, Fujishiro T, Nakaya Y, Hayama S, Nakano A, Fujiwara K, Neo M. Hidden coexisting pathology diagnosed after cervical surgery in patients with degenerative cervical myelopathy or myeloradiculopathy: A case series report. J Clin Neurosci 2021; 93: 253-258.*
10. *Xiao LX, Liu CS, Zhong SZ, Huang WH, Huang WH. Effect of a traction exercise neck brace on cervical spondylopathy radiculopathy: A clinical study and finite element analysis. Evid Based Complement Alternat Med 2021; 13: 8825150.*
11. *Huang X, Yan H, Su Z, Wang J, Zhang J, Zhang X. Clinical efficacy of combination of oxaliplatin and vascular intervention in treatment of advanced cervical cancer and related prognostic factors. Trop J Pharm Res 2022; 21: 643-648.*
12. *Sheng SR, Wang K, Nisar M, Chen JX, Wu AM, Wang XY. A novel technique for cervical facet joint hyperplasia-spondylotic radiculopathy by laminar and lateral mass screw cofixations. World Neurosurg 2018; 110: e490-e495.*
13. *Adams T, Bigney E, Cunningham E, Attabib N, Abraham E, Manson N, Leroux A, Hebert J, Richardson E, Kolyvas G. Perioperative factors predict two-year trajectories of pain and disability following anterior cervical discectomy and fusion. Can J Neurol Sci 2022; 49: S54-S54.*

14. Alluri RK, Vaishnav AS, Sivaganesan A, Albert TJ, Huang RC, Qureshi SA. Cervical disc replacement for radiculopathy versus myeloradiculopathy: An MCID analysis Clin Spine Surg 2022; 35: 170-175.
15. Yoshida T, Suwazono S, Sueyoshi T, Izumi Y, Nodera H. Diagnostic usefulness of denervation edema in the multifidus muscles using 3-Tesla magnetic resonance imaging in cervical radiculopathy. Muscle Nerve 2021; 63: 365-370.
16. Mjåset C, Zwart JA, Goedmakers CMW, Smith TR, Solberg TK, Grotle M. Criteria for success after surgery for cervical radiculopathy; estimates for a substantial amount of improvement in core outcome measures. Spine J 2020; 20: 1413-1421.
17. Liang KN, Feng PY, Feng XR, Cheng H. Diffusion tensor imaging and fiber tractography reveal significant microstructural changes of cervical nerve roots in patients with cervical spondylotic radiculopathy. World Neurosurg 2019; 126: e57-e64.
18. Zhang M, Han W, Hu S, Xu H. Methylcobalamin: a potential vitamin of pain killer. Neural Plast 2013; 2013: 424651.
19. Sawangjit R, Thongphui S, Chaichompu W, Phumart P. Efficacy and safety of mecobalamin on peripheral neuropathy: A systematic review and meta-analysis of randomized controlled trials. J Altern Complement Med 2020; 26(12): 1117-1129.
20. Wadhwa H, Sharma J, Varshneya K, Fatemi P, Nathan J, Medress ZA, Stienen MN, Ratliff JK, Veeravagu A. Anterior cervical discectomy and fusion vs. laminoplasty for multilevel cervical spondylotic myelopathy: A National Administrative Database Analysis. World Neurosurg 2021; 152: e738-e744.
21. Pinter ZW, Karamian B, Bou Monsef J, Mao J, Xiong A, Bowles DR, Conaway WK, Reiter DM, Honig R, Currier B, et al. Cervical alignment and distal junctional failure in posterior cervical fusion: a multicenter comparison of two surgical approaches. Clin Spine Surg 2022; 35: E451-E456.