

# Stellate Ganglion Block Reduces the Radicular Pain and Salivary Alpha-Amylase Activity in Patients with Cervical Spondylosis

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## Abstract

### Background

The effects of stellate ganglion block (SGB) on radicular pain associated with cervical spondylosis remain to be clarified. So we measured salivary alpha-amylase which reflects sympathetic nerve activity under psychological stress after SGB block or trigger points injection (TPI).

### Study Design

A randomized, prospective, controlled trial

### Setting

After institutional approval and informed consent, 40 patients who was suffered from neck-shoulder pain associated with cervical radiculopathy were randomly divided into two groups according to nerve block treatment. Group A (n=20, male 10 patients, female 10 patients, 50±8yr, mean±SD) received SGB and group B (n=20, male 10 patients, female 10 patients, 52±6yr) received TPI. SGB or TPI was produced by 6 ml of 1% mepivacaine a total of 5 times (twice per week). Visual analogue scale (VAS) and the concentration of salivary alpha-amylase were measured before (T0) each nerve block and 3 days (T1), 6 days (T2), 9 days (T3), 12 days (T4) and 15days (T5) after each nerve block. The consumption of non-steroidal anti-inflammatory drug (NSAID) was measured at T0 and T5 in each group.

### Results

In group A, VAS was median 74 (range 60, 78) at T0 and showed a significant decrease at T3 [53 (48, 65), p<0.05], T4 [50 (42, 66), p<0.05] and T5 [48 (26,57), p<0.05]. The concentration of salivary alpha-amylase was median 116 (range 96, 144) KU/ml at T0 and showed a significant decrease at T3 [86 (79, 105), p<0.05], T4 [79 (68, 88)] and T5 [70 (55, 84), p<0.05]. In group B, VAS and the concentration of salivary alpha-amylase showed no change throughout the time course. VAS in group A was significant lower than that in group B at T3, T4 and T5. The concentration of salivary alpha-amylase was significant lower than that in group B at T4 and T5. The consumption of NSAID in group A was significantly lower than that in group B at T5.

### Limitations

Subjects are out patients. Patients include radicular pain due to different pathogenesis, e.g., cervical herniated intervertebral disc, disc bulging, and neuro-foramen narrowing.

### Conclusion

The results indicate that SGB shows the reduction of VAS scale and the concentration of salivary alpha-amylase in patients with cervical spondylosis. These results show that salivary alpha-amylase activity could reflect the physical stress with radicular pain.

## Introduction

Although stellate ganglion block (SGB) has been commonly used for cervical radiculopathy as a nerve block treatment [1], the effects of SGB on radicular pain associated with cervical spondylosis remain to be clarified. Visual analogue scale (VAS) is used for the subjective assessment of pain but it is desirable that more objective methods could be developed. Assessment of sympathoadrenal medullary system activity is useful measurement of sympathetic pain under psychological stress [2], but only possible to date via measurement of catecholamines in blood plasma or via electrophysiological methods. Salivary biomarkers have received special attention since they are readily accessible and easily obtained. Salivary alpha-amylase has been proposed as a sensitive biomarker for sympathetic nerve activity under psychological stress [3], and a growing body of research is accumulating to support the validity and reliability of this parameter. This study was carried out to clarify the effects of SGB on radicular pain by VAS and salivary alpha-amylase activity in patients with cervical spondylosis.

## Materials and Methods

With approval of the Nagasaki Rosai Hospital Institutional Human Committee and written informed consent from each patient, we studied 40 patients who had been diagnosed by an orthopedist as having degenerative cervical spinal disease. Patients who had received cervical spinal surgery and/or had a severe cervical spinal stenosis with myelopathy were excluded from the study. Patients who had the impairment of the salivary secretion, the medicine concerning the suppression of salivary secretion, e.g., antidepressant, hypertension, and diabetes mellitus also were excluded. None of patients had steroids before study.

The use of non-steroidal anti-inflammatory drugs (NSAIDs) was continued throughout the study. Patients suffered from neck-shoulder pain associated with cervical radiculopathy and showed positive Spurling's test and the restriction of neck motion (Table 1). Plane X-rays showed cervical structural degenerative changes, including spur formation, hypermobility state and/or disc narrowing. Magnetic resonance imaging (MRI) showed spondylotic changes, cervical herniated intervertebral disc, disc bulging and/or neuroforamen narrowing. None of patients showed myelopathic neurological deficits including muscle atrophy, motor weakness, marked abnormal tendon reflex or gait disturbance.

Table 1. Patient characteristics

	Group A	Group B	P
n	20	20	NS
Age (years)	50±8	52±6	NS
Gender (male/female)	10 / 10	10 / 10	NS
Level of nerve root lesion (n)			
C5 nerve root	6	5	NS
C6 nerve root	12	13	NS
C7 nerve root	2	2	NS
Symptoms (n)			
Neck-shoulder-arm pain	20	20	NS
Radicular pain	20	20	NS
Physical findings (n)			
Restriction of neck motion	20	20	NS
Spurling test (+)	20	20	NS
Period until starting treatment (days)	8±5	10±4	NS

Values are mean±SD.

NS = not significant

Patients were randomly divided into two groups by means of a computer generated randomization list. Group A (n=20, male 10 patients, female 10 patients, 50±8yr, mean±SD) received SGB and group B (n=20, male 10 patients, female 10 patients, 52±6yr) received trigger points injection (TPI) at neck-shoulder by same pain clinician.

SGB or TPI was produced by 6 ml of 1% mepivacaine a total of 5 times (twice per week). SGB was performed with a 25-gage needle in anterior approach using a common land-mark method. TPI was performed with a 27-gage needle at neck-shoulder trigger points. Horner's sign due to SGB was verified by a second investigator. After each nerve block treatment, the patients were kept at a rest supine position for 30 minutes.

The variables were measured by a third investigator blinded to the type of nerve block treatment. The concentration of salivary alpha-amylase was measured by Amylase monitor (CM-2,1, Nipro Co. Ltd. Osaka, Japan) using a reagent paper containing 2-chloro-4-nitrophenyl-4-o-beta-D-galactopyranosylmalto-side (Gal-G2-CNP, Toyobo Co. Ltd., Osaka, Japan)[4]. Mouthwash was performed just before the measurement of the concentration of salivary alpha-amylase and the average value of a series of 3 measurement was obtained. The study was performed for outpatients in the morning.

VAS and the concentration of salivary alpha-amylase were measured before SGB or TPI (T0) and 3 days (T1), 6 days (T2), 9 days (T3), 12 days (T4) and 15 days (T5) after SGB or TPI. The consumption of non-steroidal anti-inflammatory drug (NSAID) was measured at T0 and T5 in each group.

Interval variables were expressed in mean±SD and ordinal variables are presented as median (range). The Mann-Whitney U test was used for

evaluation of differences between groups, followed by Wilcoxon's rank sum test. The Chi square test and Wilcoxon's signed rank test was applied on paired data. A value of  $p < 0.05$  was considered significant.

## Results

There was no incidence of nerve injury, hypotension, hematoma, or abscess in any trial. Patient characteristics were similar in two groups (Table 1). In group A, VAS and the concentration of salivary alpha-amylase showed significant decreases at T3, T4 and T5 compared to the values at T0, respectively (Table 2 and Table 3). In group B, VAS and the concentration of salivary alpha-amylase showed no significant change throughout the time course (Table 2 and Table 3). VAS in group A was significantly lower than that in group B at T3, T4 and T5 (Table 2). The concentration of salivary alpha-amylase was significantly lower than that in group B at T4 and T5 (Table 3). The consumption of NSAID in group A was significantly lower than that in group B at T5 (Table 4).

Table 2. Changes in VAS

Time course	Group A	Group B
T0	74 (60,78)	80 (68, 89)
T1	68 (56,71)	78 (72, 91)
T2	66 (58,69)	76 (59, 84)
T3	53 (48,65) † #	82 (66, 90)
T4	50 (42,66) † #	84 (75, 92)
T5	48 (26,57) † #	71 (61, 88)

Values are median (range). †  $p < 0.05$  vs. T0, #  $p < 0.05$  Group A vs. Group B

T0=before each nerve block, T1=3days after each nerve block, T2=6days after each nerve block, T3=9days after each nerve block, T4=12days after each nerve block, T5=15days after each nerve block

Table 3. Changes in concentration of salivary alpha amylase (KU/ml)

Time course	Group A	Group B
T0	116 (96, 144)	107 (86, 131)
T1	102 (78, 132)	121 (108, 153)
T2	100 (81, 111)	116 (96, 142)
T3	86 (79, 105) †	109 (91, 115)
T4	79 (68, 88) † #	123 (110, 158)
T5	70 (55, 84) † #	106 (91, 129)

Values are median (range). †  $p < 0.05$  vs. T0, #  $p < 0.05$  Group A vs. Group B

T0=before each nerve block, T1=3days after each nerve block, T2=6days after each nerve block, T3=9days after each nerve block, T4=12days after each nerve block, T5=15days after each nerve block

Table 4. Consumption of non-steroidal anti-inflammatory drug (Loxoprofen sodium hydrate (mg))

Time course	Group A	Group B
T0	182.6 (136, 196)	190.4 (171, 217)
T5	52.4 (48, 113) \$&	167.3(155, 194)

Values are median (range). \$  $p < 0.01$  vs. T0, &  $p < 0.01$  Group A vs. Group B

T0=before each nerve block, T5=15days after each nerve block

## Discussion

This study shows that SGB is effective for neck-shoulder pain relief, and salivary alpha-amylase activity could reflect the physical stress of radicular pain in the patients with cervical spondylosis.

It is well known that salivary alpha-amylase secretion depends on the activity of sympathetic-adrenal-medullary (SAM) system [3]. Salivary alpha amylase correlates closely with the increase of arterial blood pressure, heart rate [4] and the concentration of plasma catecholamine [5] and the acceleration of adrenergic activity in the frequency analysis of heart rate variability [6]. The mechanisms of acceleration of salivary alpha-amylase secretion due to SAM system include an indirect effect due to hormone with catecholamine and a direct effect due to the stimulation of beta receptors in salivary gland [7]. Salivary alpha-amylase can be indicators of the activity of SAM system and indirect sympathetic activity and is established as a non-invasive marker of psychological and physiological stress [8]. Arai Y-C et al. [9] reported that intra-operative music significantly decreased salivary amylase activity undergoing inguinal hernia repair under epidural anesthesia in surgical patients resulting from the relaxing effect.

On the other hand, pain stimulation affects the stress response of SAM system and accelerates the activity of salivary alpha-amylase secretion [10]. Shirasaki et al. [11] reported that after epidural block the decrease of salivary alpha-amylase correlated with the reduction of pain scale in patients with chronic pain.

Conservative treatments rather than surgery have been applied for pain management in cervical radiculopathy without motor deficits. Fukusaki et al. [1] reported that as conservative treatment for cervical radiculopathy, nerve blocks are useful for earlier relief of severe pain, but the effect of SGB alone has not been mentioned. The sympathetic nerves have an important effect on nerve root blood flow in animal studies.

In the present study, radicular pain and the concentration of salivary alpha-amylase showed a significant reduction after SGB. It seems probable that sympathetic nerve block due to SGB increases the blood flow of nerve roots with radiculitis in cervical radiculopathy and might wash-out the inflammatory substances. The reduction of salivary alpha-amylase might be due to the reduction of radicular pain and the suppression of the activity in SAM system by SGB.

The acceleration and the activity of salivary alpha-amylase are affected by various factors. They include emotional, physical and physiologic factors [12-14]. This study was produced under regular and same situation in various factors. The patients were given the sufficient rest and lie before and after receiving each nerve block treatment under comfortable music.

The study limitations may include following factors. Subjects are out patients. Patients include radicular pain due to different pathogenesis, e.g., cervical herniated intervertebral disc, disc bulging, and neuro-foramen narrowing. However, the pathogenesis was due to cervical spondylotic changes and showed typical cervical radicular pain.

Although we discuss the reduction in salivary alpha-amylase activity reflects the physical stress, we do not measure the stress markers and/or heart rate variability. Further study is needed to clarify the effect of direct sympathetic nerve activity in SGB.

In conclusion, the results indicate that SGB shows the reduction of radicular pain and the concentration of salivary alpha-amylase in patients with cervical spondylosis, and salivary alpha-amylase activity could reflect the physical stress with radicular pain.

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