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ORIGINAL ARTICLE

Efficacy of ultrasound-guided suprascapular nerve block treatment in patients with painful hemiplegic shoulder

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Abstract

Objective The aim of this study was to evaluate the efficacy of ultrasound-guided suprascapular block treatment in patients with painful hemiplegic shoulder whose pain was not reduced after conservative treatment.

Design The patients were those whose hemiplegic shoulder pain was not reduced by standard conservative treatment prior to discharge. The study group ($n = 21$) included patients who had undergone an ultrasound-guided suprascapular nerve block (SSNB). The control group ($n = 21$) were patients who had not undergone SSNB. Both groups undertook home exercise programs. All patients were evaluated at 1 week and 1 and 3 months after the discharge. Evaluations included shoulder range of motion (ROM), Visual Analog Scale (VAS) for pain, EQ-5D-3L for quality of life, the Modified Ashworth Scale (MAS), and Brunnstrom staging.

Results The shoulder ROM significantly increased in the SSNB group at 1–3 months, when compared with the baseline value. The shoulder ROM significantly decreased ($p < 0.05$) in the control group at 1–3 months, when compared with the baseline value. The pain VAS and EQ-5D-3L scores significantly decreased ($p < 0.05$) after treatment in the follow-ups at 1 month in the SSNB group. The control group showed no change from the baseline scores ($p > 0.05$). The MAS scores and Brunnstrom staging did not differ between the two groups.

Conclusion The ultrasound-guided SSNB is a safe and more effective treatment than conservative treatment for painful hemiplegic shoulder. Further studies are needed to compare ultrasound-guided and non-guided suprascapular blocks as treatments for hemiplegic shoulder pain.

Keywords Ultrasound-guided suprascapular nerve block · Painful hemiplegic shoulder · Suprascapular nerve

Introduction

Stroke is the second most common cause of mortality and the third most frequent cause of disability in the worldwide [1]. One common complication that may develop after stroke is painful hemiplegic shoulder (PHS), which occurs in 50–80% of hemiplegic patients with persistent upper extremity disability. This pain may diminish in a few months in some patients; however, most patients suffer hemiplegic shoulder pain for years [2].

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Shoulder pain in patients with stroke impedes their range of motion (ROM), decreases hand function, delays functional recovery, restricts daily life activity, and causes an increased rate of depression by decreasing the efficacy of treatment and quality of life [3]. Local pain with periosteal retraction, caused by spasticity, particularly affects the subscapular muscle. In addition, soft tissue injuries can arise in the shoulder due to the deterioration of glenohumeral rhythm as a further consequence of spasticity [4, 5]. Glenohumeral subluxation associated with flaccidity causes stretching and trapping of the peripheral nerve and triggers soft tissue lesions [4, 6]. Rotator cuff tendinopathy, impingement, biceps tendinopathy, bursitis, adhesive capsulitis, and myofascial pain in the shoulder region are counted as soft tissue lesions [4, 6, 7]. Alterations in peripheral and central nerve system activation lead to peripheral nerve entrapment, shoulder-hand syndrome, and central post-hemiplegic pain [4, 8]. All these pain-causing factors trigger the development of central sensitization with spontaneous pain in the shoulder region [4] Central poststroke pain resulting from primary lesion in the central nervous system is also responsible for shoulder region pain [4].

Currently, PHS has no optimal treatment methods, largely due to the absence of a consensus on the pain etiology [3, 9]. Different treatment modalities are recommended for patients with PHS, including the suprascapular nerve block (SSNB) [10]. A few studies on the PHS syndrome have examined treatment with SSNB, but no study has yet evaluated the efficacy of ultrasound-guided SSNB in patient with PHS. Therefore, the aim of the present study was to compare the efficacy of ultrasound-guided SSNB to that of conservative treatment in patients with PHS.

Material and methods

Ethical approval (Bakırköy Sadi Konuk Research and Training Hospital no: 2017–1316) and written informed consent were obtained. This is a cross-sectional study. All patients selected from hospitalized patients. This study include 47 hemiplegic patients who had ongoing shoulder pain lasting more than 3 months, aged 30–75 years selected during hospitalization. All patients were treated with conservative treatment while they were in hospital. The study group consisted of 21 patients who had undergone a single ultrasound-guided SSNB for shoulder pain at the end of the hospitalization, just before hospital discharge. This study group went home after SSNB and undertook a home exercise program. The control group consisted of 20 patients who still had shoulder pain during discharge. This control group went home with shoulder pain and undertook the same home exercise program with study group. The only difference of study group is single SSNB treatment during discharge from hospital. The follow-ups of all patients were prospectively performed at 1 week and at 1 and 3 months after treatment of SSNB.

Exclusion criteria included patients with stroke for less than 3 months, diabetes mellitus, anticoagulant and antiaggregant treatments, hemorrhagic stroke, or Mini Mental Test scores below 21. Two patients from the SSNB group and 4 patients from the control group were excluded due to missing data and follow-up problems. The data were evaluated for all patients after conservative treatment (Fig. 1).

The conservative treatment program administered to all patients in the study consisted of transcutaneous electrical nerve stimulation (TENS) and the same exercise program during hospitalizations before SSNB. TENS was performed 30-min session only once in each day for 4 week with a conventional method using two transarticular electrodes. TENS treatments were applied by physiotherapist.

SSNB was performed by the same experienced doctor using a MyLab60 model a high resolution 7–12-MHz linear probe ultrasonography device (Italy). The suprascapular fossa was observed by placing the probe in the transverse position to the superior of the spina scapula from the posterior of the patient, with the patient in the sitting position. A solution of betamethasone dipropionate plus betamethasone sodium phosphate (6.43 mg/mL + 2.63 mg/mL; 1 mL), 10% lidocaine (2 mL), and physiologic serum (2 mL) was injected with the in-plane technique using a 22 gauge 90-mm injector.

The patients were asked not to participate in other treatment programs and to continue the home exercise program during the follow-up period. The exercise program consisted of passive and active-assistive ROM exercises (3 sets daily, 20 times in each set). Follow-ups were performed at 1 week and 1 and 3 months after initiation of the study.

The spasticity in the shoulder was evaluated in accordance with the Modified Ashworth Scale (MAS). Brunnstrom staging was used to identify motor function levels in the upper extremity and hand. ROM for abduction, flexion, internal rotation, and external rotation were passively measured. The degree of pain was assessed using a Visual Analog Scale (VAS). Pain levels were measured as the means of all passively conducted ROM tests. VAS scores were also used in the evaluation of how the shoulder pain affected the general condition. The EQ-5D-3L scale, which scores five health conditions (mobility, self-care, usual activities, pain/discomfort, and anxiety/depression) through evaluation at 3 levels (no problems, some problems, or extreme problems), was used to evaluate the quality of life [11].

Statistical analysis

The mean, standard deviation, median, range, frequency, and ratio values were used in the descriptive statistics of the data. The Kolmogorov-Smirnov test was used to evaluate the distribution of the variables. The independent samples *t* test and Mann-Whitney *U* test were used in the analysis of quantitative independent data. The Wilcoxon test was used in the analysis of quantitative dependent data. The Chi-square test was used in the analysis of qualitative independent data, and Fisher's test was used when Chi-square test conditions were not met. The Statistical Package for the Social Sciences (SPSS) version 22.0 software was used in the analysis.

Results

Statistical analysis was performed with a total of 41 patients who completed the study (SSNB group $n = 21$, control group $n = 20$). The mean age of the patients was 65.1 ± 8.8 years in the SSNB group and 62.7 ± 10.5 years in the control group ($p > 0.05$). No significant difference was noted between the groups regarding the age, sex, BMI, hemiplegic side, and time of stroke at the baseline evaluation ($p > 0.05$) (Table 1).

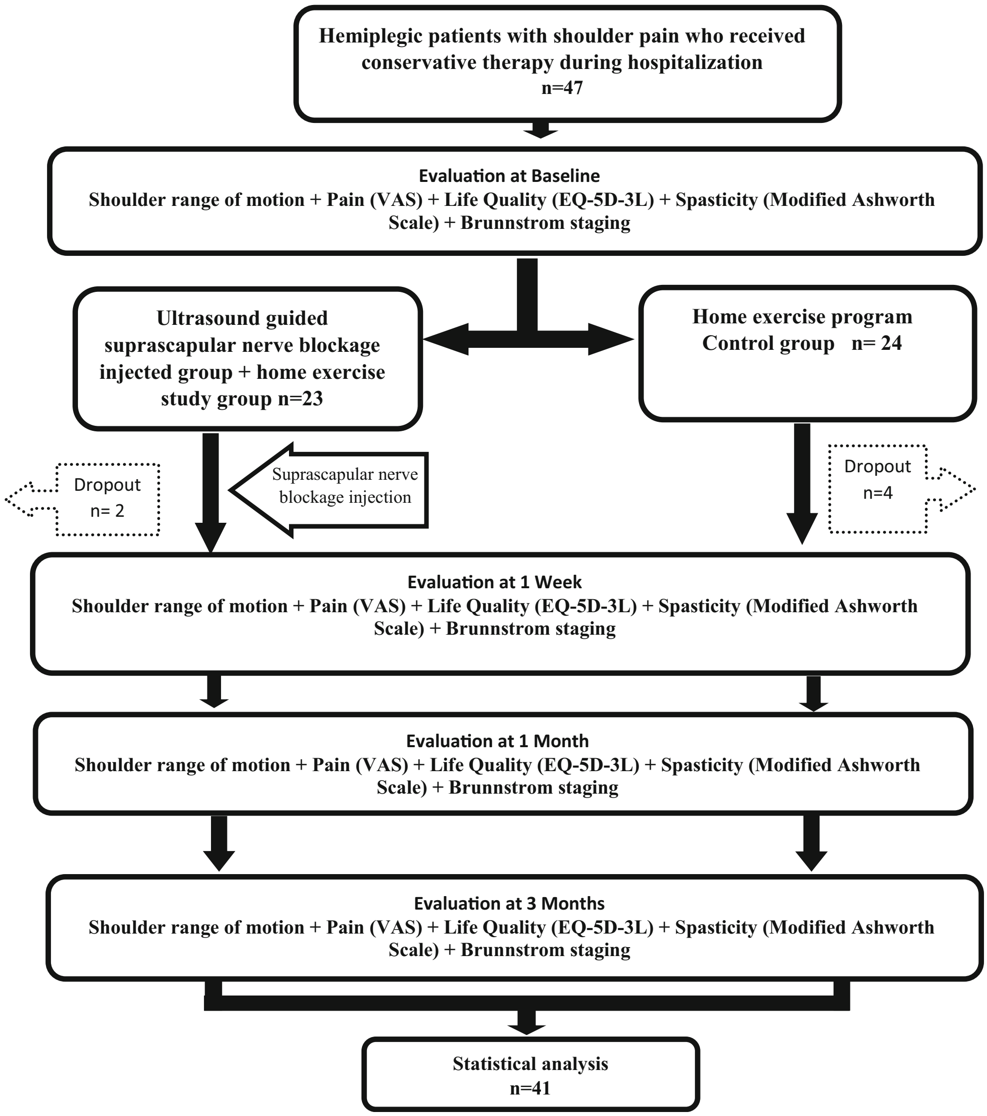

Fig. 1 Study design (VAS, Visual Analog Scale)

Shoulder range of motion

A significant increase in the degrees of shoulder flexion, abduction, internal rotation, and external rotation were evident at 1 week and 1 and 3 months in the SSNB group when compared with the baseline values ($p < 0.05$) (Table 2).

No significant change was observed in the shoulder flexion of the control group at 1 week when compared with the

Table 1 Patients data of the groups

		SSBN group				Control group				p
		Mean ± SD/n-%			Median	Mean ± SD/n-%			Median	
Age		65.1	±	8.8	67.0	62.7	±	10.5	63.5	0.457[m]
Sex	Female	13		61.9%		10		50.0%		0.443X^2
	Male	8		38.1%		10		50.0%		
BMI		27.66	±	4.01	26.16	27.73	±	4.27	27.30	0.876[m]
Hemiplegic side	Right	7		33.3%		9		45.0%		0.440X^2
	Left	14		66.7%		11		55.0%		
Time of stroke		4.43	±	1.72	4.00	5.20	±	2.02	5.00	*0.344*[m]

[m] Mann-Whitney *U* test

X^2 Ki-kare test

Table 2 Shoulder range of motion within and between groups of patients with painful hemiplegic shoulder treated with a suprascapular nerve block (SSNB) or no nerve block treatment (control)

	SSNB group		Control group		p
	Mean ± SD	Median	Mean ± SD	Median	
Shoulder flexion					
Before treatment	108.10 ± 25.62	100.00	104.50 ± 23.50	100.00	0.601[m]
BT/AT change ratio 1st week	17% ± 14%	11%	− 1% ± 5%	0%	0.000[m]
Intra-group change p	0.000[w]		0.257	w	
BT/AT change ratio 1st month	16% ± 23%	20%	− 4% ± 9%	0%	0.000[m]
Intra-group change p value	0.006[w]		0.041[w]		
BT/change ratio 3rd month	6% ± 29%	0%	− 5% ± 10%	− 5%	0.009 [m]
Intra-group change p	0.045[w]		0.028[w]		
Shoulder abduction					
Before treatment	96.90 ± 21.94	90.00	93.25 ± 16.49	90.00	0.544 [m]
BT/AT change ratio 1st week	18% ± 18%	11%	− 4% ± 7%	0%	0.000 [m]
Intra-group change p value	0.000[w]		0.008[w]		
BT/AT change ratio 1st Month	16% ± 33%	11%	− 5% ± 9%	0%	0.002[m]
Intra-group change p value	0.024[w]		0.010[w]		
BT/change ratio 3rd month	14% ± 27%	10%	− 5% ± 10%	0%	0.002 [m]
Intra-group change p	0.020[w]		0.019[w]		
Shoulder internal rotation					
Before treatment	75.14 ± 25.82	90.00	74.75 ± 21.24	80.00	0.484 [m]
BT/AT change ratio 1st week	92% ± 270%	11%	0% ± 8%	0%	0.008 [m]
Intra-group change p value	0.021[w]		1.000[w]		
BT/AT change ratio 1st month	105% ± 303%	11%	− 1% ± 12%	0%	0.013 [m]
Intra-group change p value	0.032[w]		0.959[w]		
BT/change ratio 3rd month	99% ± 267%	11%	1% ± 15%	0%	0.018 [m]
Intra-group change p value	0.002[w]		0.746[w]		
Shoulder external rotation					
Before treatment	64.52 ± 25.19	70.00	56.75 ± 17.86	60.00	0.301[m]
BT/AT change ratio 1st week	27% ± 46%	7%	15% ± 52%	0%	0.040[m]
Intra-group change p value	0.005[w]		0.039[w]		
BT/AT change ratio 1st month	42% ± 70%	29%	10% ± 54%	0%	0.017[m]
Intra-group change p value	0.018[w]		0.787[w]		
BT/change ratio 3rd month	40% ± 72%	13%	13% ± 54%	0%	0.164[m]
Intra-group change p value	0.039[w]		0.475[w]		

SSNB suprascapular nerve blockage, *BT* before treatment, *AT* after treatment

[m] Mann-Whitney *U* test

[w] Wilcoxon test

baseline value ($p > 0.05$); however, a significant decrease was detected at 1 month and 3 months when compared with the baseline values ($p < 0.05$). A significant decrease was detected in the shoulder abduction in all control patients when compared with their baseline values ($p < 0.05$). No significant change was detected in the shoulder internal rotation in the control patients when compared with their baseline values ($p > 0.05$). A significant increase was detected in external rotation at 1 week when compared with before treatment ($p < 0.05$); however, no significant change was detected at 1 and 3 months when compared with the baseline values ($p > 0.05$) (Table 2).

The increase in shoulder flexion, abduction, internal rotation, and external rotation in the SSNB group at 1 week and at 1 and 3 months was significantly greater than in the control group ($p < 0.05$) (Table 2).

Visual Analog Scale

A significant decrease was detected in the degree of pain as evaluated using the VAS in the SSNB group after at 1 week, 1 month, and 3 months when compared with the degree before treatment ($p < 0.05$); however, no significant change was detected in the general pain score in the control group at any time point ($p > 0.05$). The decrease in VAS scores at each time point was significantly larger in the SSNB group than in the control group ($p < 0.05$) (Table 3).

EQ-5D-3L

A significant decrease was detected in EQ5D-3L scores in the SSNB group at 1 week and at 1 and 3 months, when compared with the baseline values ($p < 0.05$). No significant change was detected in EQ5D-3L scores in the control group at 1 week or at 1 or 3 months ($p > 0.05$). The decrease in EQ5D-3L scores at 1 week and at 1 and 3 months was significantly higher in the SSNB group than in the control group ($p < 0.05$).

Modified Ashworth Scale

There was no statistical difference in the MAS scores of the shoulder in either group at any time point when compared with the baseline values ($p > 0.05$).

No statistical difference was found in the ratio of change in the MAS scores of the shoulder and hand in either group at any time point when compared with the baseline values ($p > 0.05$).

Brunnstrom staging

No statistical difference was detected in the Brunnstrom scores of the upper extremity and hand in either group at any time point, when compared with the baseline values ($p > 0.05$). The intergroup comparisons also showed no statistically significant difference in the ratio of change in Brunnstrom scores of the upper extremity and hand at any time point, when compared with the baseline values ($p > 0.05$).

Discussion

Painful shoulder syndrome is an annoying condition seen in 50% of hemiplegic patients. Although various methods are available for the treatment of this disorder, many patients continue to complain of pain and loss of range motion for years.

The suprascapular nerve receives the sensation of 70% of the shoulder joint, and its afferent fibers may become entrapped by injured tissues or sensitized due to chronic pain in chronic shoulder pain conditions [12]. SSNB treatment was found effective for the treatment of shoulder pain in rheumatoid arthritis and degenerative arthritis [13]; however, the number of SSNB studies in patients with PHS is limited in the literature. For example, Allen et al. [13] investigated hemiplegic patients with shoulder pain using non-guided SSNB (using a steroid and local anesthesia) and compared this treatment to subcutaneous lidocaine injection from the posterior of the shoulder; both groups also underwent physiotherapy programs. In a randomized controlled study, Adey-Wakeling et al. administered a corticosteroid + local anesthesia combination to a non-guided SSNB group consisting of 64 stroke

Table 3 Shoulder pain (VAS) changes within and between groups of patients with painful hemiplegic shoulder treated with a suprascapular nerve block (SSNB) or no nerve block treatment (control)

	SSNB group				Control group				p
	Mean ± s.d.			Median	Mean ± s.d.			Median	
Before treatment	6.33	±	1.88	6.00	5.33	±	1.15	5.00	0.107^{m}
BT/AT change ratio 1st week	− 33%	±	25%	− 29%	3%	±	18%	0%	0.000^{m}
Intra-group change p value	0.000^{w}				0.334^{w}				
BT/AT change ratio 1st month	− 32%	±	39%	− 29%	11%	±	40%	0%	0.001^{m}
Intra-group change p value	0.003^{w}				0.124^{w}				
BT/change ratio 3rd month	− 23%	±	29%	− 29%	9%	±	36%	0%	0.002^{m}
Intra-group change p value	0.001^{w}				0.176^{w}				

[m] Mann-Whitney *U* test

[w] Wilcoxon test

SNNB suprascapular nerve blockage, *VAS* Visual Analog Scale, *BT* before treatment, *AT* after treatment patients with PHS and compared this to subcutaneous local anesthesia to a control group [14]. The non-guided SSNB using local anesthesia and steroid conducted by Allen's and Adey-Wakeling's groups confirmed that SSNB was effective in decreasing pain and increasing upper extremity function. Similarly, Jeon et al. [3] and Yasar et al. [15] also performed non-guided SSNB using local anesthesia only in PHS patients and compared with intraarticular injection. They found that non-guided SSNB and intraarticular injection decreased pain and increased ROM, but no one treatment was superior to the others [3, 15].

These previous studies validated the use of non-guided SSNB using local anesthesia with steroid or only local anesthesia as an effective treatment for the pain and limited shoulder ROM in patients with PHS. However, no study on SSNB treatment with ultrasound guidance has yet been published regarding patients with PHS. We used a corticosteroid and local anesthesia combination for the SSNB group in our study, but we used ultrasound guidance for its administration. We also found a decrease in pain and an increase in shoulder ROM in the SSNB group compared to control group, as reported previously for non-guided SSNB.

Chang et al. showed the efficacy of SSNB in chronic shoulder pain in a meta-analysis of 11 randomized controlled studies, which included non-stroke patients [12]. They found that SSNB was superior to physical treatment and placebo, and had a similar efficacy to intraarticular injections [12]. Chang et al. also reported that ultrasound-guided SSNB was superior to the non-guided SSNB (surface landmark or fluoroscopy-guided techniques) [12]. Some researchers have also compared the efficacy of SSNB to that of physical therapy [16]. Boonsong et al. performed non-guided SSNB to one group of 10 patients with PHS, and ultrasonography (1.0–2.0 watt/cm^2, 10 min) on another group and found that the non-guided SSNB was faster and more effective at decreasing pain. However, the effects of both treatment methods were similar in terms of the improvement of ROM [16].

A limited number of studies have investigated the efficacy of SSNB in improving quality of life [17]. However, an improvement in the quality of life, in addition to the alleviation of pain, is important for functionality in patients with hemiplegia. Picelli et al. administered a suprascapular steroid and local anesthesia combination in 10 patients with PHS for a period longer than 2 years and detected a decrease in VAS, an increase in shoulder ROM, and an increase in quality of life, similar to our findings [17].

Although positive results were obtained in the present study for pain alleviation and ROM following the SSNB treatment, this treatment had no positive effect on spasticity, which was evaluated using the MAS, or on motor function, which was evaluated using the Brunnstrom staging. This suggested that alleviation of shoulder pain was not effective at preventing the neurologic sequelae of hemiplegia. Possibly, if SSNB had been performed in the early period following stroke, it might have been effective at improving motor function because the use of the painful extremity would have increased. However, the patients in our study had chronic hemiplegia, and SSNB is used as a rescue therapy in the late period in our clinic. Future studies should therefore be planned in which patients would undergo SSNB treatment earlier to see if this might improve subsequent motor function.

Although there were studies that non-guided SSBN is better than physical therapy methods, our study showed ultrasonography-guided SSBN is better than physical therapy methods also. We need new studies comparing non-guided SSBN with ultrasonography-guided SSBN to understand which one is superior in treatment of PHS.

The superiority of our study was its use of different evaluation measures, the follow-up durations of 3 months, and the use of ultrasound guidance to perform the SSNB. The disadvantage of our study is that it was not a randomized controlled trial and it included only a limited number of patients. We also were unable to compare guided SSNB with non-guided SSNB, because no SSNB treatments are conducted without ultrasound guidance in our clinic.

Conclusion

The ultrasound-guided suprascapular nerve block is a safe treatment for hemiplegic shoulder pain and is more effective than conservative treatment. A comparison of ultrasound guided and non-guided suprascapular block treatment should be conducted in future studies of painful hemiplegic shoulder.

Compliance with ethical standards

Conflict of interest Financial disclosure statements have been obtained, and no conflicts of interest have been reported by the authors.

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