Original Article

Suprascapular Nerve Block versus Intra-articular Steroid Injection for Hemiplegic Shoulder Pain: A Preliminary Double-Blind Randomized Controlled Trial

Tuan Farhan Tuan Ibrahim, Anwar Suhaimi and Soo Chin Chan
Department of Rehabilitation Medicine, University of Malaya Medical Centre, Kuala Lumpur, Malaysia

ABSTRACT

Objectives: To compare the analgesic efficacy of two alternative injections in improving passive shoulder range of motion and shoulder function in patients with hemiplegic shoulder pain.

Study design: A double-blind randomized controlled trial.

Setting: Rehabilitation Medicine Clinic, University Malaya Medical Centre, Kuala Lumpur, Malaysia.

Subjects: Patients with hemiplegic shoulder pain of at least two weeks duration were recruited into this study

Methods: Either a suprascapular nerve block or an intra-articular steroid injection were administered to all patients. Maximal tolerable passive range of motion and the corresponding numerical rating scale pain score were documented at pre-injection and at one hour, one month and three months post-injection. The Shoulder Pain and Disability Index questionnaire was completed by the participants at pre-injection and at one month and three months post-injection. All outcome measures were analysed using repeated measures ANOVA.

Results: Thirty-one patients were enrolled in this study. The mean age was 57.7 years (SD 8.1). Mean stroke duration was 16.9 months (SD 24.2). Twenty-six of the strokes (83.9%) were of ischaemic aetiology. Significant pain reduction, passive range of motion and shoulder pain and disability index over time were evaluated in both groups. The intra-articular steroid group had an analgesic effect earlier (at one month) than the suprascapular nerve block group (at three months). No significant differences in pain, shoulder passive range of motion or shoulder pain and disability index between the two groups were observed at any point in this study.

Conclusions: Neither injection technique was found to be superior in terms of pain reduction, passive range of motion increase or reduction in Shoulder Pain and Disability Index score. However, this result could be due to the small sample size. The intra-articular steroid group evidenced an analgesic effect at one month, earlier than the suprascapular nerve block group.

Keywords*:* hemiplegia, shoulder pain, stroke, scapular nerve block, intra-articular steroid injection

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Introduction

Hemiplegic shoulder pain is a common clinical consequence of stroke, with a frequency reported to be as high as 84%.[1] Although hemiplegic shoulder pain can occur as early as one-week post-stroke, the onset is more common at two to three months.[2] Hemiplegic shoulder pain can be due to musculoskeletal and/or neuropathic causes. Musculoskeletal causes include structural injury from glenohumeral subluxation, capsular contracture or rotator cuff pathology, impingement syndrome, bicipital tendinopathy, adhesive capsulitis and myofascial pain.[3] Neuropathic causes of hemiplegic shoulder pain include central poststroke pain and peripheral nerve entrapment.[3]

Patients with hemiplegic shoulder pain manifest with pain on passive movement of the shoulder as well as limitations on the range of motion of shoulder movement. Poorly managed hemiplegic shoulder pain can affect post-stroke rehabilitation participation resulting in significant disability and reduction in quality of life.[2,4] Management of hemiplegic shoulder pain focuses on reducing pain, improving active and passive range of motion (PROM), shoulder positioning with slings or strapping, massage therapy, percutaneous electrical muscle stimulation and intramuscular botulinum toxin injection.[5]

Minimally invasive treatment of hemiplegic shoulder pain with intra-articular shoulder steroid injection and suprascapular nerve block have lately gained interest. Published studies have reported significant reduction of pain both after suprascapular nerve block and after intra-articular steroid injection compared to placebo.[6,7] However, head-to-head comparisons of the analgesic effects of suprascapular nerve block versus intra-articular steroid are limited.[8,9] Studies done to date comparing both injection methods only followed patients for up to one month. There have been no studies so far comparing the functional outcome between these two minimally invasive methods.

In this randomized double-blinded control trial, we compared the analgesic effect of suprascapular nerve block and

Correspondence to: Anwar Bin Suhaimi, MBBS, MRehabMed; Department of Rehabilitation Medicine, University of Malaya Meical Centre, Jalan Prof. Diraja Ungku Aziz, 59100, Kuala Lumpur, Malaysia; E-mail:anwar@ummc.edu.my

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of intra-articular steroid among members of the Malaysian stroke population. We also evaluated improvement in passive shoulder range of motion and functional outcome using the Shoulder Pain and Disability Index (SPADI) for up to three months following the minimally invasive interventions.

Methods

An unfunded prospective, single centre, double-blinded, parallel group preliminary randomized control trial was conducted in the Rehabilitation Medicine Clinic, University Malaya Medical Centre. The study was registered with Clincialtrials.gov (NCT04128605, protocol ID 201945-7301) as well as the Malaysian National Medical Research Register, Ministry of Health, Malaysia (NMRR-19-2997-3554). This study received ethical approval from the University of Malaya Medical Centre Medical Research Ethics Committee (MEC ID Number: 201945-7301).

The sample size was calculated based on a previous study using G*Power 3.1.9.2. to have a power of 0.8 and an alpha value of 0.05.[9] With allowance for a 25% attrition rate, a total of 86 subjects were needed for this study. Statistical analysis was done using Statistical Package for Social Science (SPSS) software version 20 for tests of normality, the independent t-test for continuous data, the chi-square test for categorical data and repeated measure analysis of variance (ANOVA) for changes over time and for between group comparisons of primary and secondary outcomes.

Eligible subjects were recruited over an 11-month period between July 2019 and June 2020; data collection for the 3 months of follow-up was completed by September 2020. The inclusion criteria were stroke evidenced by brain lesion recognized on Computed Tomography or Magnetic Resonance Imaging scans, hemiplegic shoulder pain of at least two weeks of duration, age between 20-70 years, minimal pain score of at least 3 out of 10 on movement as expressed using the numerical rating scale (NRS) and a Mini Mental State Examination score of at least 24 out of 30.

The exclusion criteria were neuropathic pain including chronic regional pain syndrome or central poststroke pain, severe aphasia, previous trauma to the affected shoulder, preexisting shoulder pain prior to the stroke, previous shoulder injection within three months of the study and spasticity of the latissimus dorsi and pectoralis major muscles with a Modified Ashworth Scale (MAS) score of at least 3.

A co-investigator randomly assigned the subjects using a computer-generated randomization sequence to one of the two study arms in a 1:1 ratio. The allocation was done prior to the injection and was known only by the interventionist who was not involved in the assessment of the patients. The subjects and the investigator performing the assessment (Tuan Ibrahim TF) were blinded from the intervention allocation. On enrolment, demographic data including duration and aetiology of stroke, shoulder ultrasound findings and MAS for pectoralis major and latissimus dorsi muscles were documented. Clinical assessments included maximum tolerable PROM for shoulder flexion, abduction, internal and external rotation as well as the corresponding pain intensity expressed in NRS. Shoulder PROM were measured with a goniometer with the subject in the supine position and the shoulder stabilized. Shoulder flexion and abduction PROM were measured with the elbow in extension; internal and external rotation were measured with elbow flexed at 90° and shoulder abducted at 90° with the forearm in the mid-prone position. SPADI pain and disability components were included in the functional assessment. Clinical and functional assessments were repeated after one hour, one month and three months by the investigator who was blinded to the intervention allocation.

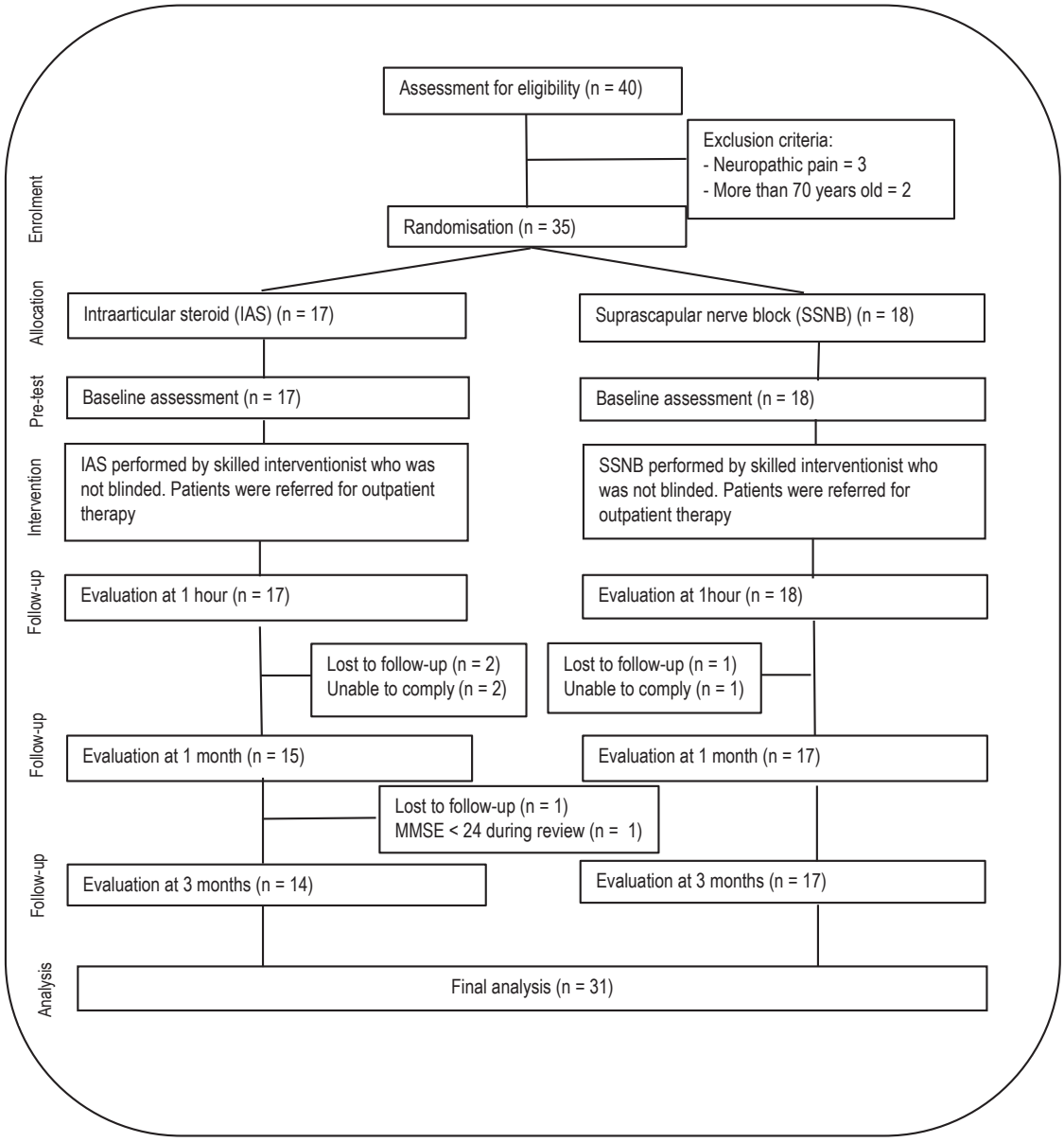
Shoulder injections were performed by a skilled interventionist (Suhaimi A), who was not blinded for safety reasons. Injections were given at the posterior aspect of the affected shoulder under ultrasound guidance while the subject was asked to face away from the injection. The suprascapular nerve block was performed by infiltrating the site of the needle insertion with Lidocaine 1% following sonographic identification of the suprascapular fossa. After cutaneous anaesthesia, a 22-gauge spinal needle (Spinocan, B. Braun) was directed towards the target under sonographic guidance. A mixture of 5 mL of Bupivacaine 0.5%, 5 mL of Lidocaine 1% and 10 mL of normal saline was delivered with real-time visualisation of the needle tip during the procedure. Intra-articular steroid injection was also performed under sonographic guidance following cutaneous anaesthesia of the area posterolateral to the acromion. The glenohumeral joint was accessed posteriorly under sonographic guidance to confirm the needle tip position between the posterior labrum and the humeral head. A mixture of 40 mg of Triamcinolone Acetonide and 2 mL of Lidocaine 1% was delivered with real time visualisation of the needle tip shaft.

Results

Out of the 35 patients enrolled in the study, 4 were lost to follow-up while 31 patients completed the study: 14 patients in the intra-articular steroid group and 17 patients in the suprascapular nerve block group. The baseline demographic data are described in Table 1. There were no statistically significant differences in demographic data between the two groups ($p < 0.05$).

We also documented shoulder ultrasound findings of patients performed prior to the interventions as described in Table 2 below. There were no statistically significant differences between the two groups in the ultrasound findings except for the occurrence of subacromial subdeltoid bursitis ($p = 0.003$) and mixed echogenicity of subscapularis which were higher in the suprascapular nerve block group ($p = 0.036$).

The MAS for spasticity of the pectoralis major and the latissimus dorsi were documented prior to injection. There were no statistically significant differences between the two



MMSE, Mini mental state examination

Figure 1. Flow chart showing patients' progress through the study

Table 1. Demographic comparison of patients in the intra-articular steroid group and the suprascapular nerve block group

	Intra-articular steroid (n = 14)	Suprascapular nerve block (n = 17)	*p*-value
Gender (male: female)	9:5	8:9	0.337[a]
Mean age (years)[1]	58.64 (7.38)	56.88 (8.85)	0.557[b]
Duration of stroke (months)[1]	15.79 (19.58)	17.88 (27.98)[1]	0.815[b]
Affected side[2]			
- Right	6 (42.9)	12 (70.6)	0.119[a]
- Left	8 (57.1)	5 (29.4)	
Aetiology of stroke[2]			0.467[a]
- Ischaemia	11 (78.6)	15 (88.2)	
- Haemorrhagic	3 (21.4)	2 (11.8)	

[1]Mean (SD), [2]Number (%)

[a]Chi-square test, [b]Independent t-test

($p > 0.05$) was considered statistically significant

Table 2. Comparison of shoulder ultrasound findings between the intra-articular steroid and the suprascapular nerve block groups

Ultrasound findings	Intra-articular steroid (n = 14)	Suprascapular nerve block (n = 17)	*p*-value
No scan done	2 (14.3)	1 (5.9)	0.665
No abnormality detected	0 (0)	1 (5.9)	0.356
Bicipital tendinitis	11 (78.6)	13 (76.5)	0.889
Subacromial subdeltoid bursitis	1 (7.1)	10 (58.8)	0.003
Mixed echogenicity supraspinatus	5 (35.7)	6 (35.3)	0.981
Mixed echogenicity subscapularis	5 (35.7)	1 (5.9)	0.036
Acromioclavicular joint pathology	2 (14.3)	3 (17.6)	0.800
Dynamic impingement	3 (21.4)	3 (17.6)	0.791

Number (%), Chi-square test

Table 3. Comparison of pre-injection measurements between intra-articular steroid and suprascapular nerve block groups

Measurement	Intra-articular steroid	Suprascapular nerve block	*p*-value
NRS			
Flexion	6.71 (2.23)	4.82 (2.32)	0.029*
Abduction	7.21 (2.29)	6.24 (1.39)	0.194
Internal rotation	5.86 (2.38)	5.06 (2.11)	0.330
External rotation	6.43 (2.14)	5.76 (2.28)	0.413
Average	6.55 (1.86)	5.47 (1.58)	0.090
PROM			
Flexion	106.64 (27.39)	116.88 (21.41)	0.252
Abduction	89.64 (16.48)	87.58 (14.07)	0.711
Internal rotation	61.50 (16.53)	54.53 (19.71)	0.301
External rotation	26.43 (16.42)	39.71 (21.99)	0.072
SPADI			
SPADI-total	65.99 (16.61)	61.88 (13.86)	0.459
SPADI-pain	55.32 (20.00)	51.56 (17.05)	0.576
SPADI-disability	73.56 (19.51)	69.36 (20.76)	0.569

Mean (SD); Independent t-test, *significant at $p < 0.05$

NRS, numerical rating scale; PROM, passive range of motion; SPADI, Shoulder Pain and Disability Index

groups for either MAS of the pectoralis major ($p = 0.708$) or the latissimus dorsi ($p = 0.664$).

There were no significant differences between the two groups in assessments of pre-injection for maximum tolerable PROM and corresponding NRS measured at passive flexion, abduction, internal rotation, external rotation or average NRS except for NRS at shoulder flexion which was higher in the intra-articular steroid group ($p = 0.029$) as shown in Table 3. There were likewise no significant pre-injection differences in SPADI, SPADI-Pain or SPADI-Disability between the two groups ($p > 0.05$).

NRS of both groups at maximum tolerable passive flexion, abduction, internal rotation, external rotation as well as average NRS were measured at four different times: pre-injection; one hour, one month and three months post-injection. Measurements changed significantly with time ($p < 0.05$) as shown in Table 4. However, there were no significant differences in NRS at flexion, abduction, internal rotation and external rotation or in average NRS between the two groups at any point after injection.

Figures 2 and 3 below show the mean changes in NRS in all four planes of shoulder movement as well as the average NRS at specified post-injection periods in both groups. It was noted that both groups showed improvement of pain both at one hour and at three months compared to baseline.

The suprascapular nerve block group showed incremental increases in pain between one hour and one month after treatment in all four planes of shoulder movements with the average NRS having declined again at three months. Average NRS, on the other hand, showed a similar reduction in both groups from pre-injection to three months: 2.1 (31.8%) reduction in NRS in the intra-articular steroid group and 1.6 (30.1%) reduction in the suprascapular nerve block group.

Maximum tolerable PROM of both groups at flexion, abduction, internal rotation, external rotation also changed statistically significantly with time as shown in Table 5. Similar results were observed in repeated measurements of SPADI, SPADI-Pain and SPADI-Disability at pre-injection, one month and three months in both groups. However, there were no significant differences between the groups for PROM at flexion,

Table 4. Repeated measures ANOVA of Numerical Rating Scale (NRS) for flexion, abduction, internal rotation and external rotation within subject factors and between group comparisons

Outcome measure	Intra-articular steroid	Suprascapular nerve bloc	Repeated measures ANOVA within subject factor		Between group comparison
			F	P	P
NRS Flexion			4.264	0.007	
Pre	6.71 (2.23)	4.82 (2.32)			0.029
1 hour	4.43 (2.68)	4.06 (2.46)			0.692
1 month	4.71 (3.20)	5.47 (2.43)			0.460
3 months	4.71 (3.02)	3.94 (2.84)			0.470
NRS Abduction			8.26	0.000	
Pre	7.21 (2.29)	6.24 (1.39)			0.194
1 hour	4.64 (2.79)	4.64 (2.45)			0.996
1 month	4.57 (2.24)	5.59 (2.87)			0.289
3 months	5.00 (3.01)	4.41 (2.83)			0.580
NRS Int rotation			4.810	0.008	
Pre	5.86 (2.38)	5.06 (2.11)			0.330
1 hour	4.07 (2.76)	4.00 (2.40)			0.939
1 month	3.93 (3.12)	4.35 (2.74)			0.690
3 months	3.57 (3.20)	2.82 (3.15)			0.519
NRS Ext rotation			3.795	0.013	
Pre	6.43 (2.14)	5.76 (2.28)			0.413
1 hour	4.21 (2.94)	4.76 (2.36)			0.567
1 month	4.86 (2.66)	5.18 (2.92)			0.755
3 months	4.86 (3.16)	4.12 (2.85)			0.499
Average NRS			6.696	0.001	
Pre	6.55 (1.86)	5.47 (1.58)			0.09
1 hour	4.34 (2.58)	4.37 (2.23)			0.974
1 month	4.52 (2.53)	5.15 (2.47)			0.490
3 months	4.54 (2.85)	3.82 (2.55)			0.469

Mean (SD)

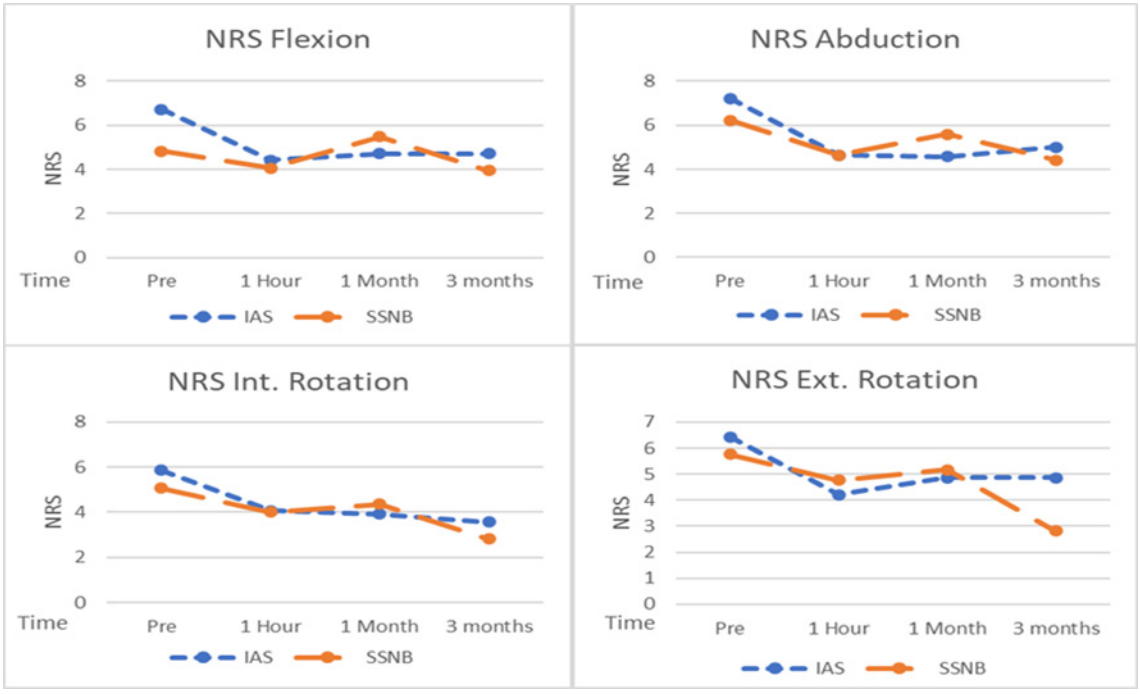


Figure 2. Line chart showing changes over time in means of NRS at maximum tolerated flexion, abduction, internal and external rotation over time for the IAS and SSNB groups

NRS, numerical rating scale; IAS, intra-articular steroid; SSNB, suprascapular nerve block

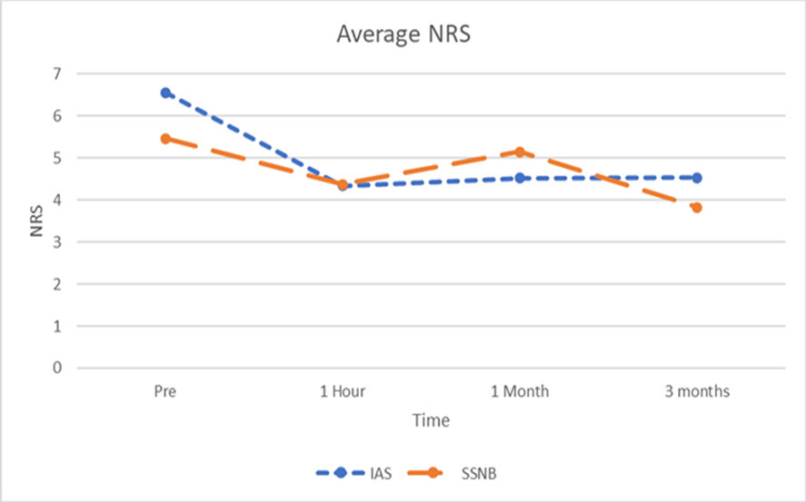


Figure 3. Line chart showing changes over time of average NRS for the IAS and SSNB groups

NRS, numerical rating scale; IAS, intra-articular steroid; SSNB, suprascapular nerve block

Table 5. Repeated measures ANOVA of shoulder passive range of motion (PROM) and Shoulder Pain and Disability Index (SPADI) within subject factor and between group comparison ($p < 0.05$)

Outcome measure	Intra-articular steroid	Suprascapular nerve bloc	Repeated measures ANOVA within subject factor		Between group comparison
			F	P	P
	PROM flexion		6.653	0.000	
Pre	106.64 (27.39)	116.88 (21.41)			0.252
1 hour	124.00 (23.49)	133.59 (22.80)			0.260
1 month	128.50 (20.25)	128.24 (18.78)			0.970
3 months	120.64 (28.35)	132.18 (20.74)			0.201
	PROM abduction		4.529	0.005	
Pre	89.64 (16.48)	87.58 (14.07)			0.711
1 hour	102.50 (22.14)	101.76 (26.50)			0.935
1 month	100.64 (18.70)	102.29 (27.06)			0.848
3 months	100.50 (20.53)	104.65 (32.00)			0.679
	PROM Int rotation		4.016	0.010	
Pre	61.50 (16.53)	54.53 (19.71)			0.301
1 hour	63.86 (16.54)	70.59 (21.47)			0.345
1 month	74.36 (16.62)	63.53 (19.75)			0.114
3 months	70.86 (16.44)	70.06 (17.59)			0.898
	PROM Ext rotation		6.225	0.001	
Pre	26.43 (16.42)	39.71 (21.99)			0.072
1 hour	41.36 (23.98)	48.53 (21.35)			0.386
1 month	39.43 (20.06)	48.76 (18.10)			0.184
3 months	39.86 (19.33)	45.65 (18.81)			0.406
	SPADI		23.455	0.000	
Pre	65.99 (16.61)	61.88 (13.86)			0.459
1 month	48.08 (20.94)	49.36 (19.69)			0.862
3 months	47.44 (23.26)	40.18 (21.51)			0.375
	SPADI-pain		21.839	0.000	
Pre	55.32 (20.00)	51.56 (17.05)			0.576
1 month	27.74 (26.55)	35.79 (20.08)			0.344
3 months	25.89 (28.95)	27.79 (24.14)			0.843
	SPADI-diability		13.616	0.000	
Pre	73.56 (19.51)	69.36 (20.76)			0.569
1 month	63.76 (24.07)	59.08 (24.44)			0.597
3 months	63.00 (23.99)	47.95 (28.12)			0.124

Mean (SD)

Figure 4. Line chart showing means of changes of maximum tolerable PROM at flexion, abduction, internal and external rotation with time for IAS and SSNB group.

PROM, Passive range of motion; IAS, Intra-articular steroid; SSNB, Suprascapular nerve block

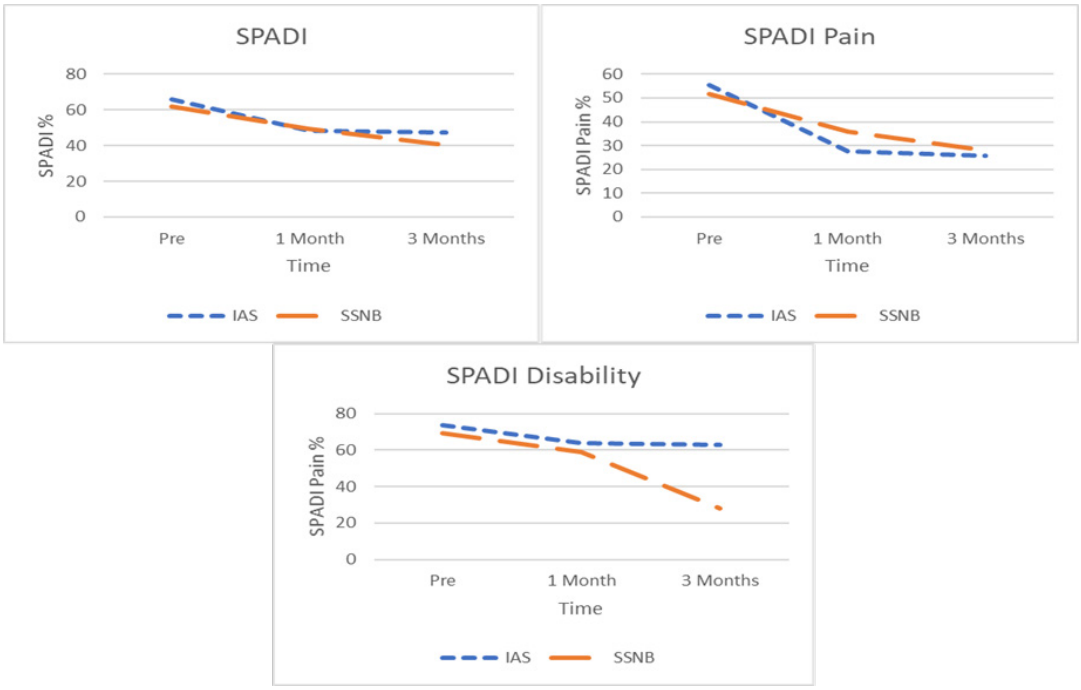


Figure 5. Line chart showing changes in means of SPADI, SPADI Pain and SPADI Disability scores with time for the IAS and SSNB groups.

SPADI, Shoulder pain and disability index; IAS, Intra-articular steroid; SSNB, Suprascapular nerve block

abduction, internal rotation or for SPADI, SPADI-Pain and SPADI-Disability at any time point after injection.

Figures 4 and 5 above show the mean changes in PROM in flexion, abduction, internal rotation and external rotation as well as SPADI, SPADI-P and SPADI-D with time in both groups. The most notable change in PROM from pre-injection to three months in the intra-articular steroid group was in external rotation where improvement of 13.4 degrees (50.8%) was observed. In the suprascapular nerve block group, PROM in internal rotation improved most between pre-injection and three months, by 15.5 degrees (28.5%).

Out of the 3 SPADI scores, SPADI Pain showed the most improvement with time in both groups: 29.4 in mean difference (53.2%) in the intra-articular steroid group and 23.8 (46.1%) in the suprascapular nerve block group.

Discussion

This study found that both intra-articular steroid and suprascapular nerve block showed statistically significant improvement in the primary outcome of pain reduction with time but neither injection method was found to be superior to the other. Similar results were observed for secondary outcome measures of PROM in all four planes of shoulder movement and in outcome measures of SPADI, SPADI-Pain and SPADI-Disability scores.

Both interventions were found to be safe and produced similar outcomes at three months in patients with hemiplegic shoulder pain. To the best of our knowledge, this is the first study that compared the efficacy of intra-articular steroid and suprascapular nerve block on hemiplegic shoulder pain and PROM scores that followed the subjects for up to three months and also included functional outcome measures of SPADI. Shoulder ultrasound findings were documented along with spasticity of the latissimus dorsi and pectoralis major.

Both groups showed significant improvement in pain between baseline and three months, with an average NRS reduction of 2.1 (31.8%) in the intra-articular steroid group and 1.6 (30.1%) in the suprascapular nerve block group. These NRS reductions exceeded the minimal clinically important difference (MCID) standard for changes in pain intensity in chronic musculoskeletal pain (a score of one, representing a 15% reduction).[10]

However, in the suprascapular nerve block group, the pain relief effect became pronounced later (at three months). NRS at all four planes of shoulder movements showed an increment of pain at one month in the suprascapular nerve block group but not in the intra-articular steroid group. This result is not consistent with a similar study done earlier that reported a visual analogue score increment for pain at one month in all three groups: the intra-articular steroid group, the suprascapular nerve block group and the combination group.[9]

One explanation for the increase in pain at one month in the suprascapular nerve block group in this study is the higher number of patients with subacromial subdeltoid bursitis in that group: 10 (58.8%) compared to one (7.1%) in the intra-articular steroid group. Subacromial subdeltoid bursitis is one of the ultrasonographic features associated with hemiplegic shoulder pain.[11] The greater number of patients with mixed echogenicity of the subscapularis muscle in the intra-articular group compared to the suprascapular nerve block group (five or 35.7% versus one or 5.9%) did not influence the primary pain outcome as this ultrasound finding is not associated with hemiplegic shoulder pain.[11]

Changes in hemiplegic shoulder pain can include impaired motor control and tone changes that can lead to glenohumeral subluxation as well as spasticity.[12] Subluxation of joints such as the shoulder can cause mechanical stress to ligaments stabilizing the shoulder joint. Noxious mechanical stimuli to fibrous structures such as ligaments and fibrous capsules can elicit pain.[13] An important mechanism for heightened pain sensitivity is an increase in the mechano-sensitivity of joint afferents, as joint nociceptors can be reliably sensitized to mechanical stimuli.[14]

A variety of inflammatory mediators, e.g., bradykinin and histamine, are produced and released into the joint during pathophysiological conditions.[14] This leads to activation of arachidonic acid pathways that result in the production of prostaglandins, thromboxanes, leukotrienes and cytokines that can activate nociceptors leading to pain.[14]

Intra-articular injection of the steroid triamcinolone acetonide inhibits phospholipase A2 enzyme on the cell membranes' phospholipid layer, and thereby hinders the breakdown of leukocyte lysosomal membranes and prevents the formation of arachidonic acid.[15] It also prevents the biosynthesis of prostaglandins and leukotrienes.[16] In addition, it has anti-inflammatory effects and appears to reduce nociceptor sensitivity and central sensitization leading to a reduction of pain.[17] The resulting reduction of synovial inflammation will decrease capsular fibrosis and allow for improvement of PROM with time.[18]

Bupivacaine administered jointly with a suprascapular nerve block will bind to the intracellular portion of the voltage-gated sodium channel on axonal membranes and prevent an influx of sodium ions and depolarization causing reversible loss of sensation.[19]

Interestingly, despite the short duration of action of Bupivacaine, studies have shown that the suprascapular nerve block has a prolonged analgesic effect lasting for up to three months.[20] It has been proposed that the prolonged analgesic effect is possibly due to an effect on C fibres that interrupts the cycle of feedback amplification which can occur in chronic pain.[21] A depletion of substance P and nerve growth factor in the synovium and afferent C fibres of the glenohumeral joint after the blockade may also contribute to the longer pain relief effect.[22] Another factor contributing to longer pain relief might have been a decrease in central sensitization of the dorsal horn nociceptive neurones.[23] Based on this explanation, suprascapular nerve block might be more effective in chronic hemiplegic shoulder pain than intra-articular steroid injection, although further study is needed.

In terms of shoulder PROM, all four planes showed significant improvement with time in both groups. The greatest improvement in PROM was in external rotation in the intra-articular steroid group at 13.4° (50.8%) compared to 5.9° (15%) in suprascapular nerve group. Limitations of shoulder external rotation played an important role in shoulder pain post stroke.[24] The significant improvement of external rotation in the intra-articular steroid group leads to reduction of pain as shown by the lower average NRS at one hour which was maintained at one month and three months, unlike in suprascapular nerve block group where the average NRS increased at one month.

Improvement of PROM is important for enabling patients to perform activities of daily living. Functional shoulder range of motion for activities of daily living are 120° for forward flexion, 45° for extension, 130° for abduction, 60° for external rotation and 102° for internal rotation.[25] To be completed, most tasks require humeral elevation which, in turn, requires shoulder abduction and flexion.

In this study, both groups had achieved improvement in PROM of forward flexion at three months to greater than the functional range of motion of 120°, reaching 120.6° for the intra-articular steroid group and 132.2° for the suprascapular nerve block group. However, improvement in PROM of abduction in both groups at three months fell short of the functional range of motion of 130°. Although the shoulder range of motion improvement observed in this study was passive, it is still important in enabling the patient to perform activities of daily living after neurological recovery.

Functional outcome measurements of SPADI were made in this study. Both groups showed improvement with time in outcome measures of SPADI, SPADI-pain and SPADI-disability. However, no significant differences between the two groups were observed at any point in any of the measurements. An improvement of SPADI of 10 has been demonstrated to represent significant clinical improvement.[26] In this study, the improvement of SPADI from pre-injection to three months was significant in both groups, where the scores improved by 18.6 (28.1%) in the intra-articular steroid group and 21.7 (35.1%) in suprascapular nerve block group.

Similar improvements were observed in SPADI-Pain and SPADI-Disability. For SPADI-Pain, improvement from pre-injection to three months was 29.5 (53.2%) in the intra-articular steroid group and 23.8 (46.1%) in the suprascapular nerve block group. It is interesting to note that the improvements in SPADI-pain were greater than in SPADI-disability.

These findings are similar to a randomized control trial of the efficacy of a suprascapular nerve block for chronic shoulder pain.[20] This is likely due to the fact that participants recruited in both groups were mostly chronic stroke patients with an average duration from onset of stroke to intervention of more than 15 months. These patients are less likely to have neurological recovery of the upper limb that can be translated into improvement of function and reduction of disability.

Our study showed that neither of the two injection techniques is superior in terms of pain reduction, either PROM or SPADI. However, the intra-articular steroid group had an earlier onset of the analgesic effect (at one month) compared to the other group (at three months). SPADI-Pain showed more improvement with time in both groups compared to both total SPADI and to SPADI-Disability.

A study limitation was the inadequately small sample size. Our initial sample size calculated from the effect size of a previous study was 86. However, we were only able to recruit 35 patients, of whom four were lost to follow-up. The recruitment period was interrupted from the middle of March until the end of June 2020 due to a movement control order enacted by the Malaysian government as well as to the closure of the Rehabilitation Medicine Clinic as our hospital focused its resources on managing COVID-19 patients.

It was also difficult to ensure that participants received adequate physiotherapy sessions due to the service interruptions during the pandemic. Another aspect that we were not able to control was the quantity and type of analgesics taken by patients during the study which might have influenced pain control results.

For future research, we suggest a larger sample size to more accurately demonstrate any significant differences between the two groups. It would also be interesting to include selection of participants based on the chronicity of their stroke to investigate the efficacy of intervention in both post-acute and chronic stroke and also to lengthen the follow-up to six months. We further suggest stratification of patients based on shoulder ultrasound findings.

Conclusions

This preliminary study found that neither the suprascapular nerve block nor the intra-articular steroid injection technique is superior in terms of pain reduction, passive range of motion and shoulder pain and disability index. This finding is likely due to the small sample size of only 35 patients rather than the planned 86. However, the intra-articular steroid group did show an earlier analgesic effect at one month than the suprascapular nerve block group.

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References

1. Turner-Stokes L, Jackson D. Shoulder pain after stroke: a review of the evidence base to inform the development of an integrated care pathway. Clin Rehabil. 2002;16:276-98.
2. Poduri KR. Shoulder pain in stroke patients and its effects on rehabilitation. J Stroke Cerebrovasc Dis. 1993;3:261-6.
3. Ryerson S, Levit K. Physical therapy of the shoulder. 3rd ed. New York: Churchill Livingstone; 1997.
4. Viana R, Pereira S, Mehta S, Miller T, Teasell R. Evidence for therapeutic interventions for hemiplegic shoulder pain during the chronic stage of stroke: a review. Top Stroke Rehabil. 2012;19: 514-22.
5. Wiener J, Cotoi A, Viana R. Chapter 11: Hemiplegic shoulder pain and complex regional pain syndrome. The stroke rehabilitation evidence-based review: 18th edition (www. ebrsr.com). Canadian

Stroke Network. 2018.
6. Snels IA, Dekker JH, Van Der Lee JH, Lankhorst GJ, Beckerman H, Bouter LM. Treating patients with hemiplegic shoulder pain. Am J Phys Med Rehabil. 2002;81:150-60.
7. Adey-Wakeling Z, Liu E, Crotty M, Leyden J, Kleinig T, Anderson CS, Newbury J. Hemiplegic shoulder pain reduces quality of life after acute stroke: a prospective population-based study. Am J Phys Med Rehabil. 2016;95:758-63.
8. Yasar E, Vural D, Safaz I, Balaban B, Yilmaz B, Goktepe AS, Alaca R. Which treatment approach is better for hemiplegic shoulder pain in stroke patients: intra-articular steroid or suprascapular nerve block? A randomized controlled trial. Clin Rehabil. 2011;25:60-8.
9. Jeon WH, Park GW, Jeong HJ, Sim YJ. The comparison of effects of suprascapular nerve block, intra-articular steroid injection, and a combination therapy on hemiplegic shoulder pain: pilot study. Ann Rehabil Med. 2014;38:167-73.
10. Salaffi F, Stancati A, Silvestri CA, Ciapetti A, Grassi W. Minimal clinically important changes in chronic musculoskeletal pain intensity measured on a numerical rating scale. Eur J Pain. 2004;8:283-91.
11. Doğun A, Karabay İ, Hatipoğlu C, Özgirgin N. Ultrasound and magnetic resonance findings and correlation in hemiplegic patients with shoulder pain. Top Stroke Rehabil. 2014;21:S1-7.
12. Wilson RD, Chae J. Hemiplegic shoulder pain. Phys Med Rehabil Clin N Am. 2015;26:641-55.
13. Kellgren JH, Samuel EP. The sensitivity and innervation of the articular capsule. J Bone Joint Surg. 1950;4:193–205
14. McMahon SB, Koltzenburg M. Wall and Melzack's textbook of pain. 6th ed. Philadelphia: Elsevier Saunder; 2013.
15. Sidhu G, Preuss C. Triamcinolone [Internet]. Ncbi.nlm.nih.gov. 2020 [cited 2020 November 3]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK544309/?report=classic
16. Triamcinolone [Internet]. Pubchem.ncbi.nlm.nih.gov. 2021 [cited 2021 August 7]. Available from: https://pubchem.ncbi.nlm.nih.gov/compound/Triamcinolone
17. Romundstad L, Breivik H, Niemi G, Helle A, Stubhaug A. Methylprednisolone intravenously 1 day after surgery has sustained analgesic and opioid-sparing effects. Acta Anaesthesiol Scand. 2004;48:1223-31.
18. Marx RG, Malizia RW, Kenter K, Wickiewicz TL, Hannafin JA. Intra-articular corticosteroid injection for the treatment of idiopathic adhesive capsulitis of the shoulder. HSS J. 2007;3:202-7.
19. Bupivacaine [Internet]. Pubchem.ncbi.nlm.nih.gov. 2021 [cited 2021 August 7]. Available from: https://pubchem.ncbi.nlm.nih.gov/compound/2474
20. Shanahan EM, Ahern M, Smith M, Wetherall M, Bresnihan B, FitzGerald O. Suprascapular nerve block (using bupivacaine and methylprednisolone acetate) in chronic shoulder pain. Ann Rheum Dis. 2003;62:400-6.
21. Gado K, Emery P. Modified suprascapular nerve block with bupivacaine alone effectively controls chronic shoulder pain in patients with rheumatoid arthritis. Ann Rheum Dis. 1993;52:215-8.
22. Lewis RN. The use of combined suprascapular and circumflex (articular branches) nerve blocks in the management of chronic arthritis of the shoulder joint. Eur J Anaesthesiol.1999;16:37-41.
23. Woolf CJ. Somatic pain--pathogenesis and prevention. Br J Anaesth. 1995;75:169-76.
24. Zorowitz RD, Hughes MB, Idank D, Ikai T, Johnston MV. Shoulder pain and subluxation after stroke: correlation or coincidence? Am J Occup Ther. 1996;50:194-201.
25. Namdari S, Yagnik G, Ebaugh DD, Nagda S, Ramsey ML, Williams Jr GR, Mehta S. Defining functional shoulder range of motion for activities of daily living. J Shoulder Elbow Surg. 2012;21:1177-83.
26. Green S, Forbes A, Buchbinder R, Bellamy N. A standardized protocol for measurement of range of movement of the shoulder using the Plurimeter-V inclinometer and assessment of its intrarater and interrater reliability. Arthritis Rheumatol. 1998;11:43-52.