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Original Research Article

Effectiveness of ultrasound guided ethanol motor points block in reduction of spasticity and improvement of upper limb function in hemiplegic patients: a randomized controlled study

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ABSTRACT

Background: Stroke is the third leading cause of disability in general population commonly causing upper motor neuron syndrome complications like spasticity, which is more common in upper limb. Ethanol injection into spastic muscle is an emerging effective treatment in the spasticity management. Ethanol causes selective destruction of nerve fibers through denaturation of protein.
Methods: A randomized controlled study was conducted for a period of 2 years from March 2018 on sixty-eight hemiplegic patients to assess the effectiveness of ethanol muscle block in reduction of spasticity and improvement in functional ability. The patients were allocated into two groups (Group A and B). Group A received ultrasound guided intramuscular ethanol injection along with range of motion (ROM) exercises and wrist hand orthosis (WHO) and Group B received ROM exercises and WHO. The outcomes were measured by modified ashworth scale (MAS) for spasticity and modified version of motor assessment scale for functional improvement.
Results: Intervention group showed significant improvement in spasticity shown by reduction of MAS of elbow flexors from 3 at baseline to 1.15±0.3 at 12 weeks as compared to control group with 3 at baseline to 1.76±0.5 at 12 weeks ($p<0.05$). Upper limb function scale of study group improved from 1.5±0.8 to 3.0±0.6 at 12 weeks compared to control group 1.3±0.8 to 2.8±0.6 ($p<0.05$).
Conclusions: It can thus be concluded that intramuscular injection of ethanol accompanied by wrist hand orthosis have beneficial effect on improvement of spasticity and upper limb function.

Keywords: Ethanol block, Modified ashworth scale, Motor assessment scale, Spasticity

INTRODUCTION

Stroke is defined as rapidly developed clinical signs of focal disturbances of cerebral function: lasting more than 24 hours or leading to death, with no apparent origin other than vascular causes. Hemiplegia is the main neurological manifestation almost 90 of stroke cases. Stroke is one of the most common cause of upper motor neuron syndrome complications and spasticity is one important among them.[1] Spasticity is the velocity dependent increase in tonic stretch reflex (muscle tone) with exaggerated tendon jerks resulting from hyper excitability of the stretch reflex. The prevalence estimated of post stroke spasticity were highly variable ranging from 2 to 13%. Upper extremities are more commonly (69%) involved after stroke, and it interfere with activities of daily living and hygiene maintenance. It may contribute to overall functional disability and slowness of rehabilitation.[2]

Effective management of spasticity requires a multi-disciplinary approach both for assessment and treatment

and must be considered within a progressive approach from most conservative to most invasive therapy. The most primary approach consists of improving patients' posture, proper positioning and physical therapies. The use of centrally acting muscle relaxants like baclofen, diazepam, tizanidine are considered. Intrathecal drug administration is considered in refractory cases. Usage of splinting works on the basis of two theories. First one is the biomechanical approach which emphasized the prevention or correction of the deformity by mechanical application of splints and second is neuro physiological approach using inverse stretch reflex. Application of gentle continuous stretch to spastic muscle at sub maximal passive ROM is seen to reduce spasticity by altering threshold response to stretch of the muscle spindle and golgi tendon organs in the agonist and antagonist muscles.[3]

The use of peripheral block by local anesthetic, phenol, alcohol or botulinum toxins at motor points or nerve branches are useful interventions for management.[4] Surgical interventions like tendon lengthening, tendon transfer, capsulotomy, osteotomy, resection arthroplasty arthrodesis is considered as final options. Neuro ablative techniques like neurotomy, rhizotomy, dorsal root entry zone lesion and myelotomy are other procedures.[2]

Ethanol injection into the spastic muscle shown to be effective in reducing spasticity. The action of ethanol is mediated by its ability to denature the protein and there by destruction of both neurons and axons.[5] Alcohol can act as local anesthetic in lower concentration by decreasing sodium potassium conductance. Ultrasound guidance increases the accuracy on motor point block. It ensures the injection needle inside the target muscle and avoidance of injury to neurovascular structures in proximity.

METHODS

A randomized control study was done for a period of 2 years starting from March 2018 on 68 patients with spasticity following hemiplegia, admitted in physical medicine and rehabilitation ward, Regional Institute of Medical Sciences (RIMS), Imphal, Manipur, India.

Approval from the research ethics board, RIMS, Imphal was taken before the start of the study and written informed consent was taken from all the subjects.

Post stroke hemiplegic patients with spasticity grade ≥3 in arm and forearm muscles according to modified ashworth scale (MAS), with preserved voluntary movements in at least one group of forearm or arm muscles in the upper limb, patients with post stroke period between 3 to 12 months and age group between 35 to 65 years were included in the study. However, patients with cognitive dysfunction, fixed contracture deformity in the upper limb, hemi neglect, patients who had received previous alcohol, phenol or botulinum toxin injection, sensitivity to alcohol, aphasia, pregnancy, uncontrolled diabetes mellitus, repeated attack of stroke, unconscious patients and unwillingness for treatment and follow up were excluded from the study.

Considering 90% power and 10% drop out, a total of 68 sample size was fixed. Thirty-four patients in the intervention (Group A) and thirty-four in the control group (Group B) were selected by block randomization method. Group A consisted of 22 males and 12 females while Group B consisted of 24 males and 10 females.

Group A received ethanol motor point block plus range of motion (ROM) exercises of upper limb plus wrist hand orthosis (WHO) and Group B received range of motion exercises plus wrist hand orthosis. Both the groups received wrist hand orthosis (extended volar wrist splint) with wrist positioned at 45º dorsiflexion with metacarpo-phalangeal and interphalangeal joints in extension and thumb in extension and abduction (Figure 1). The splint was worn at least 12 hours in a day for a period of 12 weeks. They received ROM exercises of upper limb 2 times in a day for 12 weeks.

Figure 1: Patient using wrist hand orthosis.

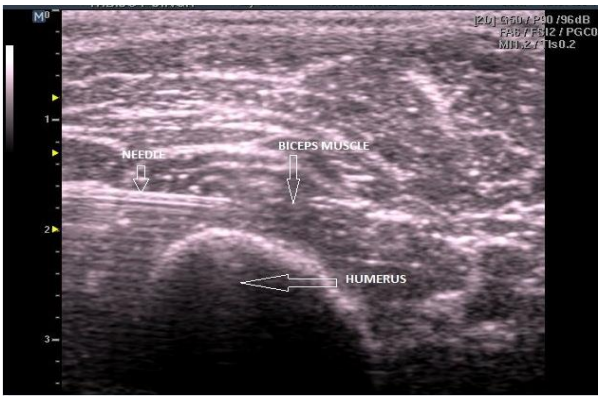

Figure 2: Musculoskeletal ultrasound image of reference line.

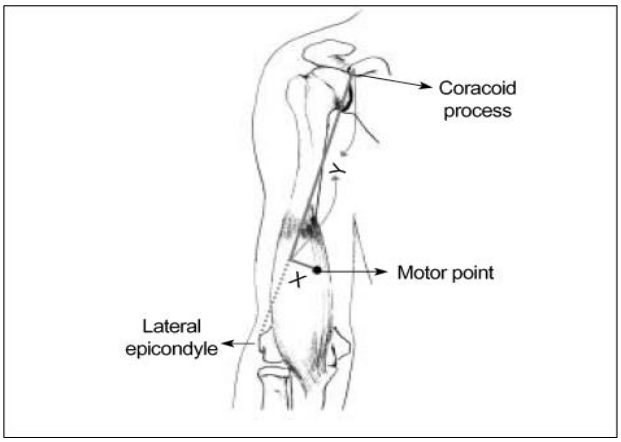

Figure 3: Location of motor point in relation to injection of alcohol at biceps muscles.

Group A patients received ultrasound guided ethanol injection of the motor points. Patient lying in supine with elbow extended and arm supinated. The motor points of biceps brachii and brachialis were identified in relation to a reference line drawn from the coracoid process to the lateral epicondyle (Figure 3). The location of motor point of biceps brachii was found approximately half of the reference line and that of brachialis muscle was at around 70% of reference line from coracoid process, 2 cm medial to the line (Figure 3). In forearm motor points of flexor carpi ulnar is, flexor digitorum pro-fundus and flexor carpi radialis were targeted. Under aseptic and antiseptic precaution 22-gauge sterile spinal needle is advanced under ultrasound guidance. Two ml of 0.25% bupivacaine is injected for local anesthesia. Location and placement of needle is correlated with ultrasound. Two ml of each 45% ethanol were injected at the motor point sites. Follow-up assessments were done at 1 week, 4 weeks and 12 weeks post intervention.

Statistical analysis

The intergroup baseline characteristics were studied using chi-square test for categorical variable and Independent t-test for continuous variables. The various outcome measures at repeated follow up were studied by non-parametric Friedman test. The comparison between study and control groups was done by Wilcoxon rank sum test.

RESULTS

Table 1 shows that there is no significant difference in the baseline characteristics between intervention and control group. The mean age of patients in intervention group was 55.7±7.3 and in control group was 53.32±6.0 years. Males were more affected by stroke; 65% and 71% respectively in intervention and control group. Left side of the body is involved in majority of patients, 70% and 76% in intervention and control group respectively. Infarct was the cause in 65 % of intervention group and 70% of control group. The spasticity and Motor assessment scale values were comparable in both the groups.

Table 2 represented progressive improvement in the outcome measures from 1 week to 4 weeks within the groups. Maximum reduction of spasticity noted at the end of 4 weeks in the intervention group, thereafter there is a slight increase in the spasticity as compared to 4th week. The upper limb function scale, hand movement activities and advanced hand activities shown progressive increase in the values at 1st, 4th and 12th week.

Table 1: Baseline characteristics of groups.

Characteristic		Intervention (n=34) (mean±SD) (N, %)	Control (n=34) (mean±SD)	P value
Mean age (years)		55.7±7.3	53.32±6.0	0.150*
Sex (%)	Male	22 (65)	24 (71)	0.269#
	Female	12 (35)	10 (29)	
Side of limb involved (%)	Left	27 (79)	26 (76)	0.086#
	Right	7 (21)	8 (24)	
Type of lesion	Infarct	22	24	0.269#
	Hemorrhage	12	10	
Duration	Months	4.5±1.1	4.4±1.1	0.947*
Occupation	Manual labourers	8	10	0.375#
	Government employees	14	10	
	Housewife	2	6	
	Businessman	10	8	
Spasticity	Biceps Grade 3	34	34	
	Finger flexors Grade 3	34	34	
Modified motor assessment scale	Upper limb function scale	1.5±0.8	1.3±0.8	0.547#
	Hand movement scale	1.0±0.2	1.0±0.4	0.923#
	Advanced hand activities	0.00	0.00	

*independent t-test, #chi-square test

Table 2: Comparison of all outcome measure at 1 week, 4 weeks and 12 weeks within the groups.

Parameter	Group	Baseline	1st week (mean±SD)	4th week (mean±SD)	12thweek (mean±SD)	P-value*
Elbow MAS mean±SD	Study	3.00	1.21±0.4	1.03±0.4	1.15±0.3	<0.05
	Control	3.00	2.88±0.3	2.12±0.3	1.76±0.5	<0.05
Wrist MAS mean±SD	Study	3.00	1.38±0.4	1.12±0.5	1.21±0.5	<0.05
	Control	3.00	2.89±0.5	2.12±0.3	1.47±0.5	<0.05
	Control	60.6±6.8º	60.8±7.6º	70±7.1º	89±8.9º	<0.05
Upper limb function scale mean±SD	Study	1.5±0.8	1.7±0.6	2.3±0.6	3.0±0.6	<0.05
	Control	1.3±0.8	1.5±0.6	2.1±0.4	2.8±0.6	<0.05
Hand movement scale Mean±SD	Study	1.0±0.2	1.4±0.5	1.9±0.4	2.4±0.7	<0.05
	Control	1.0±0.4	1.7±0.6	1.8±0.6	2.1±0.6	<0.05
Advanced hand activities Mean±SD	Study	0.00	0.02±0.1	0.3±0.4	0.8±0.6	<0.05
	Control	0.00	0.00	0.1±0.3	0.5±0.6	<0.05

*Friedman test.

Table 3: Comparison of mean score of outcome measures between groups at 1 week, 4 weeks and 12 weeks.

Parameter	Duration	Intervention (n=34) (mean±SD)	Control (n=34) (mean±SD)	P-value*
MAS elbow	1 week	1.21±0.41	2.88±0.46	<0.05
	4 weeks	1.03±0.4	2.12±0.32	<0.05
	12 weeks	1.15±0.3	1.76±0.5	<0.05
MAS wrist	1 week	1.38±0.49	2.89±0.5	<0.05
	4 weeks	1.12±0.5	2.23±0.31	<0.05
	12 weeks	1.21±0.5	1.47±0.5	<0.05
Upper limb function scale	1 week	1.7±0.6	1.5±0.7	0.11
	4 weeks	2.3±0.6	2.1±0.6	0.15
	12 weeks	3.0±0.6	2.8±0.6	0.19
Hand movement scale	1 week	1.4±0.5	1.4±0.5	1.00
	4 weeks	1.9±0.4	1.8±0.6	0.36
	12 weeks	2.1±0.5	2.14±0.6	0.83
Advanced hand activities	1 week	0.02±0.1	0.00	0.32
	4 weeks	0.32±0.4	0.11±0.3	0.05
	12 weeks	0.82±0.6	0.5±0.6	0.05

*Wilcoxon rank sum test.

At the end of 1st, 4th and 12th week, intervention group shown better reduction in spasticity than control group ($p<0.05$) as shown on Table 3. But, there is no statistically significant difference in the upper limb function, hand movement scale and advanced hand activities between the two groups. Few patients had some local erythema and local itching at the site of injection, other than that there were no major complication following ethanol motor point block.

DISCUSSION

Spasticity is a characteristic component of upper motor syndrome that complicate the rehabilitation process of many stroke patients. Spasticity also affect the quality of life and can be more diverse and highly detrimental to daily functioning. The primary approach in the management of spasticity include proper positioning of patient. Many treatment options like centrally acting muscle relaxants, surgical options like tendon lengthening, capsulotomy are being practiced currently. Ethanol injections selectively into the spastic muscles at the motor points is an emerging treatment modality. Action of ethanol is mediated through its ability to denature the protein and thereby causing neurolysis.

O'Hanlen et al, injected 45% of alcohol into multiple locations of the target muscle including the motor points which had shown significant improvement of spasticity with functional gains.[6] Kong and co-workers reported that satisfactory reduction in spasticity of elbow flexors can be obtained by blocking the musculocutaneous nerve alone.[7]

The usefulness of ethanol motor point block in reduction of spasticity and improvement of upper limb function in stroke patients was studied by this trial. To authors knowledge, the current study is the first randomized controlled trial to compare motor point block plus wrist hand orthosis and wrist hand orthosis alone in the

management of spasticity. In this study it is found that males are more prone to stroke and infarction is more common than hemorrhage 65% and 71% in study and control group respectively. In more than 70% of patients the side of affection was on left side. Cerebral infarct was more common than hemorrhage in both the groups (65% versus 35% in intervention group and 71% versus 29% in control group). Similar finding was also noted in study conducted by Akoijam and his co-workers.[8]

In this study, ethanol in a concentration of 45% is injected under real time ultrasonographic guidance into the motor points. Along with this they were advised to apply wrist hand orthosis and perform ROM exercises. Study showed significant improvement in all the outcome measures; spasticity of biceps and finger flexors, and upper limb function in both the groups at the end of 12 weeks ($p<0.05$). When both the groups were compared, study group was better in reduction of spasticity in all follow ups ($p<0.05$). In study group maximum reduction in spasticity was observed at 4th week. There was no significant difference in the function of upper limb assessed by motor limb function scale in both the groups($p>0.05$). However, there was progressive improvement of upper limb function scale, hand movement scale and advanced hand activities in both the groups as compared to baseline ($p<0.05$). It can be stated that improvement in upper limb function was not necessarily because of alcohol block. In this study, the effect of alcohol block was followed up to 3 months and maximum effect was seen at 4th week. The return of abnormal resting muscle contractility was likely due to regeneration of fusion proteins and collateral sprouting of nerve endings.

Study limitations were small sample size, few assessment tools, short follow up period, low sensitivity of MAS test. Thus, further studies with bigger sample size, longer follow up with multiple standardized assessment tools to gain unbiased results are recommended.

CONCLUSION

Ethanol motor point block using 45% absolute alcohol is useful in reduction of spasticity of upper limb in post stroke hemiplegic patients and it gives a synergistic effect when accompanied by wrist hand orthosis than using wrist hand orthosis alone but it does not translate to improvement of upper limb function of the hemiplegic patients.

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