MÆDICA - a Journal of Clinical Medicine

ORIGINAL PAPERS

Shoulder pain management in stroke

D. Poenaru, MD, PhD; D. Cinteza, MD, PhD;
S. Popescu, MD; L. Ionita, MD; M. Mateescu, MD

National Institute of Rehabilitation, Physical Medicine and Balneoclimatology, Bucharest, Romania

ABSTRACT

Background: *Shoulder pain in stroke survivors has an important negative rol in rehabilitation program. There are a number of known underlying causes of shoulder pain. The most common one is shoulder spasticity, localized on shoulder internal rotators.*

Matherial and methods: *63 stroke survivors, in a subacute phase of rehabilitation, with comunication and comprehensive facilities, sphincter control, cardiorespiratory stability and shoulder pain. Other causes than spasticity for shoulder pain were excluded. Patients were included in phase-specific rehabilitation program (the degree of joint mobility – Range of Motion – ROM, stretching, occupational therapy for upper leg function) and were randomly assign to transcutaneous electrical nerve stimulation (TENS, 31 patients) and galvanic application (33 patients) on spastic shoulder internal rotators (e.g. subscapularis muscle), for 20 minutes daily, 15 days. Both investigators and patients were blinded.*

Results: *After completion of 15 days-treatments the global functioning parameters showed an improvement in both groups with no differences between them. The pain scores had a better evolution in TENS-group. The upper extremity functional score improved in both groups. TENS-group had better result on proximal motor control than galvanic group and no difference on distal motor control.*

Conclusion: *We found that TENS application was more efficient on pain control and o proximal motor control of upper extremity than galvanic current. The underlying mechanisms of TENS efficiency may relay on pain control and spasticity reduction actions.*

Key words: stroke, shoulder pain, TENS, motor control

INTRODUCTION

Stroke is an important cause of disability in general population. Following the cerebrovascular attack, the „post-acute stroke" is a real concern of the rehabilitation team. Shoulder pain interferes with upper extremity function, with the independence degree and the quality of life (1).

There a lot of underlying causes for pain shoulder in stroke survivors. Scapulo-humeral subluxation, complex regional pain syndrome type I, soft tissue pathology or brachial neuropathy may lead to shoulder pain. But the most frequent cause of shoulder pain is spasticity. After stroke, the affected shoulder muscles are internal rotators, the most powerful of them being subscapularis (2).

The rehabilitation team uses some modalities to reduce spasticity in shoulder internal rotators. Positioning, range of motion exercises, stretching, neurofacilitation techniques are used to reduce muscular tone. Other modalities, as

Address for correspondence:
Daniela Poenaru, MD, PhD, 45b Indrumarii Street, Bucharest, Romania
email address: mpoenaru@clicknet.ro

cold or warm application were investigated. Electrical stimulation, in the form of transcutaneous electrical nerve stimulation (TENS) with different frequency, neuromuscular electrical stimulation (NMES) or functional electrical stimulation (FES), was used to obtain spasticity reduction.

TENS acts predominantly on pain; there are many theories trying to explain his action: gate control theory, opiate-mediates control theory, local vasodilatation in ischemic tissues and stimulation of acupuncture points (3). There are some studies searching the effect of TENS on spastic muscles in different pathologies (multiple sclerosis (4), stroke). ❑

MATERIAL AND METHOD

Participants: 91 patients with previous stroke, ischemic or hemorrhagic in a subacute phase.

All patients were previously admitted for acute post stroke rehabilitation.

Admission criteria: first admission in a sub acute phase, cardio respiratory stability, communication and comprehension abilities, sphincter control, shoulder pain.

Exclusion criteria were the following causes of shoulder pain in hemiparesis: scapulo-humeral subluxation (on clinical and radiological exam), soft tissue pathology – rotator cuff tears, bursitis, tendinopathies, retractile capsulitis (on clinical and ultrasound exam), heterotopic calcification (radiological scan), shoulder – hand syndrome (complex regional pain syndrome type I), on clinical and radiological exam, brachial plexus neuropathy (clinical exam).

After all these exclusions, the remaining patients were diagnosed with shoulder pain, the cause of the pain remained shoulder muscles spasticity. ❑

ASSESSMENT AND RANDOMIZATION

After signing an informed consent, the patients were randomized in two groups. Group A, 45 patients, received TENS (80 Hz, threshold intensity) 20 minutes daily on subscapularis muscle, for a total of 15 days. Group B, 46 patients, received galvanic current (threshold intensity), 20 minutes daily, for 15 days. Both groups attended concomitant physical exercises program, with the same objectives for upper extremity (posture, ROM mobility, stretching, occupational therapy). They received no pain medication, and they discontinued all previous pain medication. They received no antispastic oral therapy.

The study was conducted in a double-blinded manner: the specific procedure (TENS or galvanic application) was known neither by the patient, nor by the investigator. The blinded investigators were the PM&R residents.

Data were collected in the first day and in the last day of admission, after completion of a 15-days program of rehabilitation therapy.

Parameters were grouped as follows: demographic data (age, gender, instruction level, urban/rural provenience), stroke features (localization, type, time elapsed since stroke), global functional assessment (Barthel index (5), Activities of Daily Living Scale – ADL (6), shoulder pain assessment (Visual Analogue Scale – VAS (7)), upper leg functional evaluation (Action Research Arm Test (8) – ARAT, Motricity Index (9) – we used only the upper extremity items, Constant Murley Scale (10) – for the affected upper extremity). localization

OUTCOME

Primary outcome was shoulder pain intensity.

Secondary outcomes were upper leg function and global independence measure.

Statistical Methods and Sample Size

Data were gathered using Excel and EpiInfo Programs; they offered primary statistics analysis. The two groups were found to be comparable, by means of F-test. The significance of means comparison was tested with t Student test, with a probability $p > 95\%$. To judge the evolution of every group we used t-Test: Paired Two Sample for Means. ❑

RESULTS

The mean time elapsed from stroke to randomization was similar in both groups (A – TENS 50.4 days and B – galvanization 50.8 days).

Characteristics at Baseline for the two groups were as follows (TABLE 1). ❑

GLOBAL FUNCTIONING TESTS

ADL scale reveals a score of 2.9 for group A and 3.1 for group B. The degree of dependency

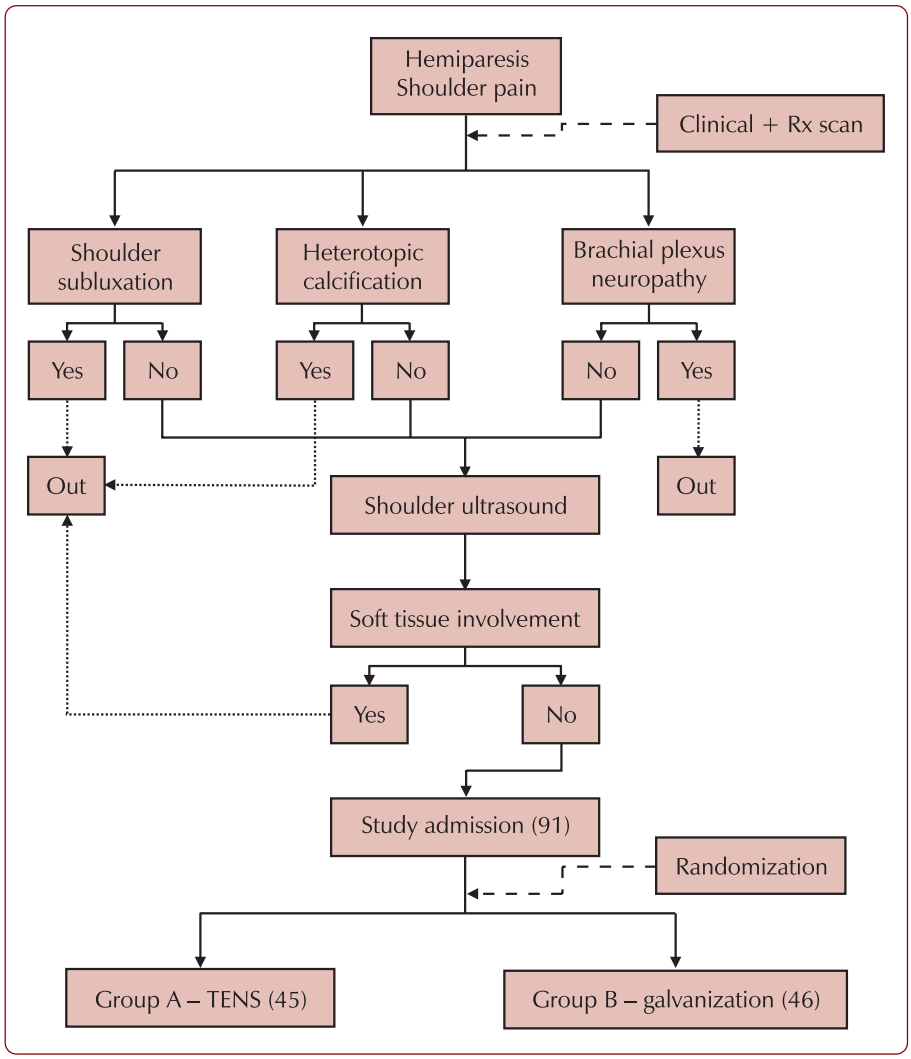

FIGURE 1. Study admission algorithm

	A – TENS	B – galvanization
Age (years): mean [SD]	60.7 [6]	62.3 [5.93]
Time since stroke (days): mean [SD]	55.4 [15.1]	50.3 [15.4]
Male (%)	64 %	58%
Hemiparesis (left)	49%	54%
Barthel Index: mean [SD]	67.2 [9.5]	70.8 [10.0]
ADL Scale: mean [SD]	2.9 [1.3]	3.1 [1.3]
VAS shoulder pain: mean [SD]	8.1 [1.24]	7.8 [1.0]
ARAT test total: mean [SD]	16.5	17.9
Grasp: mean [SD]	9.7 [3.9]	9.4 [2.7]
Grip: mean [SD]	2.7 [2.1]	2.2 [2.1]
Pinch: mean [SD]	1 [0.9]	0.7 [0.8]
Grossmt: mean [SD]	4.0 [1.9]	4.4 [1.9]
Motricity Index UE: mean [SD]	21.5 [18.2]	19.0 [15.6]
Constant Murley Scale: mean [SD]	38.6 [4.3]	39.4 [3.5]

TABLE 1. Characteristics at Baseline for the two groups were as follows

	A – TENS	B – galvanization
Barthel Index: mean [SD]	78.5 [5.0]	81.0 [6.2]
ADL Scale: mean [SD]	1.5 [0.9]	1.4 [0.9]
VAS shoulder pain: mean [SD]	3.2 [1.7]	5.1 [1.6]
ARAT test total: mean [SD]	24.3	20.1
Grasp: mean [SD]	12.3 [3.3]	10.4 [2.5]
Grip: mean [SD]	4.9 [2.2]	3.9 [2.1]
Pinch: mean [SD]	1.5 [1.0]	1.3 [0.9]
Grossmt: mean [SD]	6.8 [1.6]	5.2 [1.7]
Motricity Index UE: mean [SD]	45.0 [13.3]	33.2 [11.5]
Constant Murley Scale: mean [SD]	66.3 [3.8]	47.6 [3.4]

TABLE 2. Characteristics after 15 days of treatment

is due, mostly, to inclusion criteria, which threw away a number of patients with severe disabilities (sphincter incontinence, conscience and communication difficulties). After a complex rehabilitation program both groups improved their functional status (group A 1.5, group B 1.4). The difference between the two groups at the end of evaluation period is not significant.

Barthel index was 67 for group A and 71 for group B. After completion the 15 days period of rehabilitation both groups improved their index (to 79, respective 81). The difference between the two groups after 15 days is not significant.

Shoulder pain on VAS scale was 8 (group A) and 7.8 (group B) at the first evaluation. After the treatment period both groups have a good evolution (group A 3.2 and group B 5.1). The final results show a difference between the groups: group A reached a significant better value. ❑

UPPER EXTREMITY FUNCTIONAL SCORES

ARAT was evaluated separately for the 4 categories. Grasp scored 10 for group A and 9 for Group B. At the end of 15-days'period grasp scored 12, which was a significant difference. No difference between the two groups at the final evaluation. Both grip and pinch had a similar evolution. Only the grossmt category showed a higher improvement in group A than in group B. We suggest that TENS application was associated with this result due to its effect of spasticity reduction on internal shoulder rotators.

Motricity index was 22 (group A) and 19 (group B), with an improvement for both groups (45 for group A and 33 for group B). TENS application was associated with a better evolution of group A patients.

Constant Murley scale scored 39 for both groups at the study beginning. At the end, all patients had a significant improvement; TENS application was associated with a better outcome (66 versus 48). ❑

DISCUSSION

The inclusion and exclusion criteria offered us a special category of patients: those with a previous stroke, with previous postacute rehabilitation admission and entering in the subacute phase of post-stroke rehabilitation. All patients were conscious and cooperating, with no other major comorbidities and with sphincter control. All patients have shoulder pain. We evaluated the possible underlying causes of shoulder pain and we choose the internal shoulder rotators spasticity as the only cause of pain.

The patients were randomized in two groups, they were blinded and so were the investigators. All patients were included in a phase-specific rehabilitation program, with no analgesic oral therapy. The first group received a TENS application on main shoulder internal rotator (subscapularis muscle) and the second group received a galvanic current application on the same muscle.

The global functioning scales (Barthel and ADL) revealed an improvement of functional status in both groups, with no difference between TENS and galvanic current.

Pain scores improved in both groups, but the results were better in TENS than in galvanic applications.

Upper leg functional scores improved in both groups. Distal upper extremity control had a similar evolution in TENS-group and galvanic-group. Proximal motor control achieved better results in TENS-group.

Both galvanic and TENS application are known to reduce pain. The difference between final pain scores leads to the conclusion that TENS have a better analgesic effect. The increased shoulder motor control in TENS-group may be due to a superior analgesic effect but also to an spasticity-reducing effect.

Van Ouwenaller (11) considered shoulder spasticity the most important underlying cause of pain. Pain is an invalidating condition that impedes rehabilitation. The importance of tonus-reducing action and its analgesic effect was studied in many trials.

In 1995, Kaplan (12) mentioned range of motion exercises, optimal positioning, local TENS and ultrasound modalities. He recommended these interventions in the case of reflex sympathetic dystrophy.

Tekeoglu (13) et al, in 1998, showed that 100 Hz-TENS application in 30 – 240 days old stroke survivors improved motor functions and ADL. The patients were in subacute or chronic stage.

Sonde (14) et al., in 2000, measured the long-term effect of low-TENS (1.7 Hz) application for shoulder pain. The treatment was started late, 6-12 months after stroke, for three months and was followed for three years. Both groups (TENS and control) showed similar motor deterioration and spasticity increase, but ADL score deteriorated in control group and remained the same in TENS-group. This was a study for chronic post-stroke survivors.

In 2001, Walsh (15) mentions the positioning and neuromuscular facilitation techniques, but also the TENS modality and electrical functional stimulation.

In 1997, Heckmann (16) studied the effect of another tonus-reducing procedure on a small group (14 patients) in subacute phase. He came to the conclusion that EMG-triggered electrical muscle stimulation on spastic muscles reduces spasticity, increases motility parameters and Barthel index. Analgesia was not an outcome of his study.

Church (17) and co., in 2006, published a study on 176 stroke survivors, in the acute phase. The authors used surface neuromuscular electrical stimulation (sNMES) on spastic shoulder muscle for 4 weeks and came to the conclusion that the procedure had no impact on functional outcome and may even worsen upper leg function in those patients with severe impairment.

Other tone-reducing modalities were local injection of botulinum toxin in spastic shoulder muscles (subscapularis). Yelnik (18), in 2007, showed important reduction of shoulder pain and spasticity with botulinum A toxin in subscapularis muscle. On the other hand, de Boer (19), in 2007 found no substantial improvement after botulinum toxin administration.

Our study supports the idea that low-frequency TENS on subscapular spastic muscle in the subacute stage of hemiparesis following stroke may have benefit on shoulder pain and on proximal motor control.

REFERENCES:

1. **Duncan, P, Zorowitz, R** – Management of Adult Stroke Rehabilitation Care, *Stroke* 2005; 36:e100
2. **Gould, R, Barnes SS** – Shoulder and Hemiplegia, www.emedicine.com
3. **Kaye, V, Brandstater ME** – Transcutaneous Electrical Nerve Stimulation, www.emedicine.com
4. **Miller, L, Mattison, P –** The effects of transcutaneous electrical nerve stimulation (TENS) on spasticity in multiple sclerosis, *Multiple Sclerosis* Vol. 13, No. 4, 527-533 (2007)
5. **Mahoney Fl, Barthel DW** – Functional evaluation: the Barthel Index, *Md State Med J* 14:2, 1965
6. **Katz S, Ford AB** – Studies of illness in the aged. The index of ADL: a standardized measure of biological and phychosocial function, *JAMA* 1963 Sep 21; 185:914-919
7. **Wewers M.E., Lowe N.K** – A critical review of visual analogue scales in the measurement of clinical phenomena. *Research in Nursing and Health* 1990; 13; 227-236
8. **Lyle, RC** – A performance test for assessment of upper limb function in physical rehabilitation treatment and research, *Int J Rehabil Res* 1981; 4:483-492
9. **Collin, C, Wade, D** – Assessing motor impairment after stroke: a pilot reliability study. *J Neurology Neurosurg Psychiatry* 1990; 53:576-579
10. **Constant, C** – Assessment of shoulder function, in The Cuff, Grazielly, DF, Gleyze, P, Alsevier Manson, 1996, pg 39-43

11. **Van Ouwenaller C, Laplace PM, Chantraine A** – Painful shoulder in hemiplegia. *Arch Phys Med Rehabil* Jan 1986; 67(1):23-26
12. **Kaplan, C** – Hemiplegic shoulder pain – Early prevention and Rehabilitation, *West J Med* 1995 February; 162(2):151–152
13. **Tekeoðlu Y, Adak B** – Effect of transcutaneous electrical nerve stimulation (TENS) on Barthel Activities of Daily Living (ADL) index score following stroke, *Clin Rehabil* 1998 Aug; 12(4):277-280
14. **Sonde L, Kalimo H** – Low TENS treatment on post-stroke paretic arm: a three-year follow-up, *Clin Rehabil* 2000 Feb; 14(1):14-19
15. **Walsh, K** – Management of shoulder pain in patients with stroke, *Postgrad Med J* 2001; 77:645-649
16. **Heckmann, J, Mokrusch, T** – EMG-triggered electrical muscle stimulation in the treatment of central hemiparesis after a stroke, *European journal of physical medicine & rehabilitation* 1997, vol. 7, nº5, pp. 138-141
17. **Church, C, Price, C** – Randomized Controlled Trial to Evaluate the Effect of Surface Neuromuscular Electrical Stimulation to the Shoulder After Acute Stroke, *Stroke* 2006; 37:2995
18. **Yelnik, AP[1], Colle, FM –** Treatment of shoulder pain in spastic hemiplegia by reducing spasticity of the subscapular muscle: a randomised, double blind, placebo controlled study of botulinum toxin A, *Journal of Neurology, Neurosurgery, and Psychiatry* 2007; 78:845-848
19. **de Boer, KS, Arwert, HV –** Shoulder pain and external rotation in spastic hemiplegia do not improve by injection of botulinum toxin A into the subscapular muscle, *Journal of Neurology, Neurosurgery, and Psychiatry* 2008; 79:581-583