MULTIPLE SCLEROSIS TREATMENT: DRY NEEDLING, NEW THERAPEUTIC FRONTIERS

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ABSTRACT

Due to high prevalence of spasticity in Multiple Sclerosis (MS) and functional limitations that pain and gait alterations cause, is necessary to investigate possible benefits of Dry Needling (DN) in this pathology.
A case study of a 35 years old Secondary Progressive MS woman with 6,5 points on Expanded Disability Status Scale by performing deep DN intervention on Rectus Femoris (RF) and Gastronecmius Medialis (GM) muscles of higher spasticity lower limb was carried out. Spasticity level, perceived pain, range of motion (ROM) and superficial electromyography activity of this lower limb, together with functional capacity, life quality and Spatial-Temporal Gait parameters before and after intervention were evaluated.
After intervention, spasticity decrease (especially on RF) and gait speed increase was noticed. Also, less muscle activity on walking and less delay time of step execution was observed.
Our results suggest a functional improvement of the patient's gait motion, but conclusive changes were not objectified in pain perception and ROM. More research studies about the effect of DN in MS must be necessary in order to obtain better evidence.

INTRODUCTION

Spasticity is one of the most prevalent symptoms on patient with Multiple Sclerosis (pwMS), being one of the major cause of functional limitation and the one that could exacerbate the other symptoms of this disease (Izquierdo, 2017), such as pain and Spatial-Temporal Gait (STG) parameters. Even if sometimes lower limbs spasticity allows static and dynamic standing, some authors point that Triceps Surae muscle spasticity could have a negative impact on balance and walking (Sosnoff et al., 2011).
Gait disorders in pwMS are decreased gait velocity, shorter steps, increased double support time and decreased single support and swing times (Benedetti et al., 1999; Givon et al., 2009); nevertheless, it seems that there are differences in gait characteristics between pyramidal and cerebellar pwMS groups, where above mentioned disorders are more associated with the first group (Givon et al., 2009). The typical pyramidal gait pattern in pwMS is, therefore a slow stiff knee gait primarily caused by an excessive activation of knee extensors while pre-swing (Givon et al. 2009; Lencioni e al., 2016) and during the swing, specially the Rectus Femoris (RF), which cause the decrease of flexion peak during swing; As secondary cause seems to be a push-off deficit like in the stroke (Campanini et al., 2013), where Gastronecmius weakness could be one cause of this gait pattern (Apti et al., 2016).
Referring to our previous study about cerebral stroke toxin application on both muscles, founding improvement of spasticity but not of functionality (Zarco-Periñán et al., 2016), we prove that toxin application on pwMS is not a habitual practice due to its debilitating effect.
One of difficulties that pwMS'ss gait pattern analysis presents is the high heterogeneity among this pathology, and the high variability even in the same patient over time (Lassmann, 1999), due to diagnosis subgroups and its degenerative nature. This makes a homogeneous clinical trial investigating protocol difficult to apply, comparing to more reproducible disorders pattern as in cerebral strokes.
Dry Needling (DN) was largely used in muscular pain associated to myofascial trigger points (MTP) pathology (Espejo-Antúnez et al., 2018) and, even if existing references are limited, some randomized clinical trials have suggested its benefits in spasticity and perceived pain of some neurological diseases as cerebral stroke (Salom-Moreno et al., 2014; Mendigutia-Gómez et al., 2016; Sánchez-Mila et al., 2018), finding the first reports of clinical cases on cerebral tumor (Tavakol et al., 2019) or spinal cord injury (Cruz-Montecinos et al., 2014); also there are some referred clinical cases reports on cerebral stroke where spasticity decrease was obtained on muscles after DN treatment, besides of a passive range of motion (ROM) increasing (Herrero-Gallego & Del Moral, 2007). However, and despite its extended use, there are no published researches about application of this technique on pwMS.
The aim of this research is to assess the deep DN technique effects on spasticity, perceived pain and ROM effects in a patient with Secondary Progressive MS. As innovation regarding anterior studies on other neurological pathologies, we propose a superficial electromyography (sEMG) survey that allows us to better analyse muscular changes after DN of MTP.

MATERIALS AND METHODS

Case presentation
The patient was diagnosed with Relapsing-Remitting MS in 2009 and became a Secondary-Progressive in

2013. There are no outbreaks, but there is a progression of the disease. It has an EDSS 6.5; it makes short distances walking with the help of a walker.
The affected function systems are pyramidal tract, sensory functions, bladder/intestines and cerebellar. The disease-modifying treatment that patients have is Rituximad since 07/2018 and Fampyra since 2017 as symptomatic treatment. He was previously with Extavia until 07/2012, then Copaxone until 11/2013, went to Rebif until 03/2014 and got into a clinical trial with Siponimod until 02/2018. She presents deterioration with respect of the evaluation made 6 years ago, reported and published on 2018 (Luque-Moreno et al., 2018), when she presented, free range of motion, EMA 1+ point on the right GM and 1 on the right RF, gait speed of 4,9 m/s and cadence of 94 steps/min. In the image it shows an evolutive graphic of the last years of the patient. An actual clinical description can be seen on pre-DN of Tables 1 and 2.

Tab. 1 – Variation of parameters measured during the study

		PRE	POST
VAS	RF	2	0
	GM	0	0
ALGOMETER	RF	8,34	5,98
	GM	4,0	6,22
MAS	RF	3	1+
	GM	1+	1
ROM	DF CAVIGLIA – fless. ginocchio	20	20
	DF CAVIGLIA – est. ginocchio	10	10
	FLESS. GINOCCHIO	140	140
	FLESS. ANCA	135	130
	EST. ANCA	20	28
2MWT		9	14
MUSIQOL		55,65	69,35

Tab. 2 – Variation of the gait analysis

	PRE	POST
VELOCITY	8,6	9,6
CADENCE	28,5	28
STEP LENGHT DIFFERENTIAL	3,73	5,03

Methods
Present research describes a clinical case approved by Andalusian Ethical Committee of Biomedical Investigation (CEI of University Hospital of Virgen Macarena – Virgen del Rocio of Seville), the informed consent of evaluation, treatment and images processing, and it is part of the registered research on ANZCTR platform (Reg. Nº. ACTRN12619000880145).
Before DN intervention, an evaluation of various outputs was done in order to weight up the obtained changes after intervention. These outputs were perceived pain through Pressure Pain Threshold (PPT) and Visual Analogue Scale (VAS), spasticity, range of motion (ROM), functional capacity, life quality, PET and sEMG activity of RF and Gastronecmius Medialis (GM). All the outputs were taken on the most spastic lower limb as it had higher Modified Ashworth Scale (MAS) score. The measurements instruments were:

- Pain: before, after and during intervention VAS evaluation of pain
- PPT: perceived pain evaluation by PPT measurement using digital algometry. Pressure pain thresholds, defined as the minimum pressure force to evoke pain or discomfort (Vanderweën et al., 1996), were assessed using a digital pressure algometer, model M3 (Psymtec®), with a 1cm2 contact probe. Pressure algometry has shown high reliability as an assessment tool (Chesterton et al., 2007). Pressure pain thresholds were measured bilaterally, over the medium point of the muscle belly of the RF and GM.
- Spasticity*:* Spasticity degree was measured with MAS on RF and GM of both lower limbs. This evaluation determined the lower limb to apply DN (the one who obtained higher score, that is major spasticity), which, in our case, was the right lower limb. The Ashworth Scale (AS) and the Modified AS quantify the muscle response to an external movement, and they are used as a ‘gold standard’ to assess criterion validity for spasticity measures in many studies (aloraini et al., 2015).
- ROM: Passive ROM was measured by goniometry of ankle dorsal flexion (DF) (with and without knee flexion), knee flexion and hip flexion and extension (Table 1).
- Functional capacity: For gait evaluation, a 2 minutes walking test (2MWT) was made, validated concerning 6MWT (Scalzitti et al., 2018), because the patient presented important fatigue that prevents her walking for long periods without resting.
- Quality of life: The patient completed the *Multiple Sclerosis International Quality of Life questionnaire* (MusiQoL) (Fernández et al., 2011) to evaluate life quality and if any difference was noticed before and after the intervention.
- Spatial-Temporal Gait (STG) parameters: STG was evaluated by using GaitRite® (Luque-Moreno et al., 2018) (Figure 4), details of results in Table 2.
- sEMG activity of RF and GM: Functional sEMG of RF and GM was used, according to SENIAM (Hermens & Freriks, 1999) protocol marks on intervention side on walking (first minute of 2MWT) using mDurance (Banos et al., 2015) to evaluate both muscles functionality. Due to obtained data, there was no need to test muscular strength using other methods.

Intervention
The intervention consists of Dry Needling (DN) using disposable stainless-steel needles of 0.3 mm × 50 mm or 0.3 mm x 40 mm (Agupunt, Barcelona, Spain), depending on the depth of the muscle to be treated. The type of DN intervention that was used was the fast-in fast-out Hong technique over the middle point if the muscle belly of the RF and GM muscles, until

a minimum of 3-4 local twitch responses (LTR) were elicited. Patient's tolerance was respected, thus the female participant was told to warm the physiotherapist and stop the treatment, if necessary. The intervention will be performed in the lower limb most affected by spasticity.

A puncture will be made in each muscle per session, 1 session per week, for 2 weeks (Graphic 2). The intervention will be performed in a hospital environment. The duration of each dry needling session will be approximately 45-60 seconds for muscle until the LTR disappeared (3-4) or until the patient could no longer bear the pain, taking into account that in neurological patients the global spasm response could cover the LTR.

RESULTS

The results (Tab. 1 and 2) show improvement of perceived pain after intervention until its disappearance, decreasing 2 points on VAS of RF, without pain on GM on initial evaluation. During DN intervention the reported pain by the patient (measured during the second session of treatment) was VAS 8 points on RF and VAS 2 points on GM. Nevertheless, perceived pain measured by Algometry shows higher pain threshold on GM (improvement) and not in RF.

Spasticity measured by MAS highly improved on RF (main responsible of the rigid knee) and, to a lesser extent, on GM (taking into account that the improvement potential was lower due to the fact that we started from a lower initial evaluation). ROM measurement didn´t change, except 8º increasing of hip extension; to highlight a minor range of motion of ankle DF while knee extension comparing to knee flexion (mayor shortening of Gastronecmius).

Respecting STG parameters, gait speed improvement was observed, with no change of cadence, no significant clinical values were reached, the asymmetry of the step is maintained, with a slightly increasement However, gait speed of 2MWT increased 5 cm/s, that leads to a better time period gait potential, taking into account the walking difficulties showed on initial evaluation.

MusiQoL score increase after the intervention, meaning that a major quality of life was measured.

Regarding the electromyographic activity of the RF and GM muscles, figure 6 shows 4 walking cycles for the two measurements performed (pre and post-DN); these cycles have been isolated from the total electromyographic signal collected during the 2MWT. There are two outstanding aspects of the results obtained, there is less RF and GM activity during walking and the patient executes the 4 cycles in a shorter time.

DISCUSSION

This case report described the examination and treatment of a pwMS with DN in the lower extremity with the highest MAS score in the preintervention measurement. One of the strengths of the present report is the inclusion of electromyographic information during the 2MWT. This information allows us to determine the effect that the DN has on RF and GM during walking activity. In that way, some findings need to be discussed.

It becomes necessary the effect of DN as Invasive Physical Therapy technique vs more aggressive treatments as a botulinic toxin. Although the last one was also tested to improve walking on pwMS, the best-demonstrated indication on these patients seems to be to improve Nursing cares on great disability patients (EDSS > 7), in this case, the most frequently injected muscles are adductors and hamstrings (Gallien et al., 2012). Must take into account that, in spite of its potent capacity to reduce spasticity, the toxin debilitating effects on muscle could reduce functional capacities of pwMS who already have an important weakness and fatigue pattern.

Related to perceived pain, data are not conclusive, we found minimal changes on before and after treatment algometry, only in one of the muscles evaluated. In addition, the results measured with the VAS scale have also not been consistent. One of the possible causes of the conflicting findings is the sensitive disorders and other disease symptoms that present the patient such as neuropathic pain; nevertheless, we found an important decrease of pain sensation during first and second intervention according to VAS. Further studies with major sample size, randomized and with placebo use in order to have results contrast and to compare the effects with other techniques that seem to improve this output, such as TENS (Sawant et al., 2015), are needed.

It was remarkable the improvement of spasticity of both muscles, measured by MAS, but without change on ankle DF ROM. Shortening of Gastronecmius compared to soleus muscle (due to ankle DF with and without knee flexion), probably because, as in muscle pathology, the DN optimises the results when another complementary technique is added, such as stretching, neural mobilization etc. It would be convenient also to study this combined effect in order to discern the additional benefits of this technique.

Regarding STG parameters, according to the literature (Givon et al., 2009), the pwMS walk slower and using shorter steps with a prolonged step time, comparing to healthy subjects. Furthermore, pyramidal involvement was suggested to decrease gait velocity and step length. Due to the functional deterioration of the patient, it results difficult to attribute clinical importance to the improvement of these parameters, as the walker could have artefact the results. Despite this, during walking the RF turned more efficient thanks to Gastronecmius improvement (probably due to spasticity reduction), so we could conclude that muscle function optimizes because less muscular recruitment is necessary in order to obtain an effective response at the same stimulus.

The improvement of MusiQoL score suggests an improvement of the quality of life, probably related to the improvement of the objectified functionality (Hoermann et al., 2017).

An important aspect was that were no sides effects with the intervention, except the pain during its application, especially on RF. It would be necessary further study with bigger sample size, but we should take into account that side effects risk like hematomas that could appear in anticoagulated post cerebral stroke patients will be less in pwMS. One of the advantages of this technique is its fast application and low cost of disposable materials (acupuncture needles). For this reason, if its effect would be demonstrated, this will be an interesting complementary technique to other non-pharmacological treatments for functional improvement of pwMS.

Although the present case report presents some interesting findings of the application of DN in pwMS, there are some limitations that need to be stated. First, there is a lack of references values in the current literature; consequently, no firm conclusions can be drawn. Although the measurement was performed in the same environment and with similar parameters, the previous movement experienced by the patient and the conditions of the sEMG signals could influence the results obtained. Furthermore, a common limitation of the case reports is that no cause-effect relationships can be supported. Finally, Expectation may also play an important role in pain and functional outcomes after the use of DN. Hence, the placebo effect needs to be considered as a plausible mechanism for the observed effects DN (Cagnie et al., 2013).

CONCLUSIONS

In conclusion, the data imply a functional improvement in walking even in the case of progressive disease, however, the changes are not conclusive in perceived pain and ROM, so it would be necessary to continue research in this field to obtain greater evidence of its results.

Although the case studies do not provide definitive conclusions about the effectiveness of a technique, they allow a much more descriptive analysis of the protocol for evaluation, intervention and adaptation of the technique to a neurological pathology with such a specific clinical entity.

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Competing Interest

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