Radial Shock Waves In Painful Dystonic Retrocollis Treated Either With DBS And Botulinum: A Case Report With Short Narrative Literature Review

Shock waves in Dystonia

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***Abstract*—T *Retrocollis* (RC) is a form of cervical dystonia that produces patterned, repetitive muscle contractions resultin in a neck extension. To combine the dual effect of radial shock waves on pain and hypertonia, in this case report Radial Shock Wave Therapy was used to treat painful hypertonic neck extensor muscles in a patient with genetic-based cervical dystonia and spasmodic torticollis. The aim of the report is to report clinical effects of RSWT on cervical pain and muscle hypertonia and briefly recall emergent related literature.**

Background: Cervical dystonia is the most common form of focal adult dystonia. It manifests itself with involuntary movements and anomalous postures that interest head, neck and shoulders, which can configure complex patterns, often not of univocal interpretation. A differential element in CD, compared to other dystonic syndromes, lies in the frequent presence of "pain" (approximately 75% of cases) probably related to the intensity of muscle spasms and to the wealth of nociceptors located in the neck. The state of excessive muscle contraction can lead to intrinsic muscle changes (intrinsic hypertonia). Radial shock waves are recommended in insertional tendinopathies' treatment and painful myofascial syndromes, in order to reduce inflammation, painful symptoms and to improve the mobility of the treated area. Furthermore, recent work suggests that RSWT can reduce the hypertonicity of patients affected by cerebral palsies and strokes. This clinical improvement has been attributed to the direct effects of RSWT on muscle fibrosis and other components of intrinsic hypertonia.

Materials and methods: The patient was periodically evaluated during the entire treatment using clinical scales in order to monitorize effectiveness and her global condition. The parameters used are usually the Tsui score, one of the most widely used in the clinical context for the assessment of cervical dystonia, the VAS scale for the measurement of pain (primary outcome) and the MAS scale to determine the degree of intrinsic hypertonia (secondary outcome).

Results: The main message of the report is that RSWT induced a significant reduction of pain. The peak of this reduction was recorded after the last treatment session although a decrease in pain was noted at the end of each treatment administered. The patient generally returned to the next session with a reduced pain intensity and more tolerability than at the beginning of treatment. In our opinion RSWT had no clinically documented long lasting influence on muscle hypertonia.

Conclusions: Direct and indirect action mechanisms of the shock waves on the irradiated tissues are responsible for the immediate therapeutic effectiveness that can be clinically found, which is expressed by reduction of muscle tension and functional recovery, removal of pain, and restoration of the impaired attitude and postural balance. Despite literature about the action of focal and radial shock waves on spasticity, the treatment we gave in this experience seems to have had little long lasting effects on the neurophysiopathology of hypertonicity, although our evaluation in this sense was simply clinical and would have required a study with a larger cohort and an analysis of H-reflex and F-wave, in order to evaluate any imperceptible neurophysiological variations on spasticity.

Keywords: radial shock waves, retrocollis, painful dystonia.

I. INTRODUCTION

Introduction

Retrocollis (RC) is a form of cervical dystonia (CD) that produces patterned, repetitive muscle contractions that result in neck extension (1). As recently state by Bradnam et al.(2) an holistic approach to dystonia would support the management of a wide range of symptoms and signs that if properly addressed could meaningfully reduce disability and improve quality of life in people living with dystonia (2). Cervical dystonia (CD) is a chronic movement disorder characterised by abnormal postures of the neck. Although muscle contractions represent the most visible disease feature, associated symptoms such as pain are frequent and relevant contributors to disability. At the same time, pain constitutes one of the most important factor in terms of poor quality of life (3). Muscle pain management of CD should incorporate problems such as chronic pain, depression and anxiety in order to achieve a significant decrease in the burden of disease (3). Bradnam et al. recently recall us how CD was a neurological movement disorder where one or more body parts are afected by involuntary, sustained or intermittent muscle contractions causing abnormal postures, repetitive movements, tics or tremors (2,3). Pain is a prevalent and debilitating non-motor symptom in dystonia (3,4). In people with CD, pain is reported in 55–89% of people (5). The prevalence of pain in other dystonia types is lower than CD, with studies reporting pain was a symptom in 30–40% of people with FHD or lower limb dystonia and only 3% in BLP primarily related to photophobia pain (5). To date, pain is most commonly treated with BTX and medication and novel techniques with physical therapy as an adjuvant to BTX injections. Unfortunately, rehabilitation usually takes the form of exercises of the neck to reduce activity in contracted muscles and enhance strength and function of their antagonist muscles , with limited success. A recent classification of dystonia patterns (6) is based on the "collum-caput" paradigm (Fig. 2). With respect to the "front" position of the patient, we must identify two reference points or anatomical landmarks: the sternal notch and the laryngeal prominence (Adam's apple). In case of lateral bending or twisting of the head, they remain aligned. If, on the other hand, they do not remain aligned, it is the neck that is predominantly involved in the abnormal posture, generating a condition of stiff neck or side neck. Considering the patient in the sagittal plane, two other anatomical landmarks will be taken into consideration: the external acoustic meatus and the clavicle. In case of prevalent involvement of the head in antero- or retroflexion (antecaput and retrocaput), the external acoustic meatus remains in projection with the clavicle. In case of prevalent involvement of the neck in antero- or retroflexion (antecollection and retrocollection), the external acoustic meatus projects in front of or behind the clavicle (6-8).

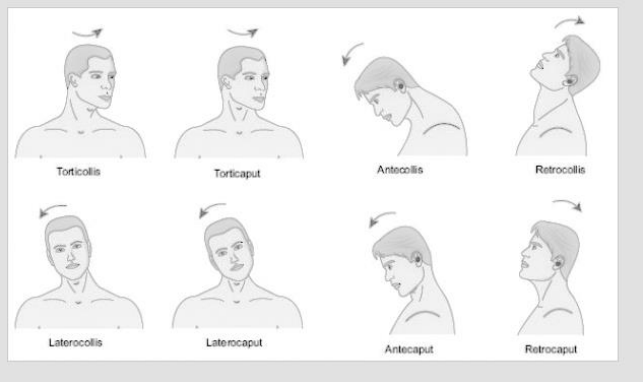

FIG. 2: THE "COLLUM-CAPUT CONCEPT" (9) (FREELY RETRIEVABLE ON LINE).

A. The treatment of CD is based on the use of few main therapeutic strategies and the chemodenervation mediated by botulinum toxin (BoNT). It is considered the first choice treatment in cervical dystonia both by the guidelines of the European Federation of the Neurological Societies (EFNS) and from American Society(10). Each single approach had been widely described (1,11,12) and in selected cases of particularly complex forms of dystonia, unresponsive to pharmacological treatments or botulinum toxin, other therapeutic solutions can be considered such as intrathecally pumped baclofen, deep brain stimulation (DBS) and selective peripheral denervation. DBS at the internal pale globe has been successfully performed in patients with generalized dystonia (13). Physiotherapy is often associated with botulinum toxin treatment of cervical dystonia, but there is no clear scientific evidence on the efficacy of rehabilitation treatments on outcome. A recent review of the literature analyzed studies investigating the efficacy of rehabilitation, alone or in combination with toxin, in cervical dystonia (14). In last decade extracorporeal shock wave therapy (ESWT) has been shown to reduce hypertonia in patients with upper motor neuron syndrome without any side effect. The aim of the present case report is to testify whether ESWT could be useful also in patients with dystonia (15) *Since first preliminarly trial reported in literature,* Extracorporeal shock wave therapy had appeared to be probably an effective and safe treatment for several kind of hypertonia , even if larger randomized studies are needed.

B. Extracorporeal Shock Wave Therapy (ESWT) is a technique introduced for the first time in the 1970s for the treatment of stones in Urology. Since the 1990s, ESWT has been introduced in the orthopedic and physiotherapy fields for the treatment of various pathologies, among which pseudarthrosis and peri-articular calcifications stand out for importance. The improvement of technology has then allowed its use in an increasingly vast field of diseases of the locomotor system (16). Since 2000, Shock Wave Therapy (SWT) has been supported by focused shock wave therapy, further expanding the spectrum of applications in the treatment of soft tissues such as muscles, fascia,

tendons. and ligaments. Physical characteristics. Shock waves are high-energy acoustic waves, produced by specific generators, conveyed through a transmission system inside the human body. They differ from traditional ultrasounds both for their pulse trend and for the achievement of decidedly higher pressure gradients of the order of 10 -100 mega Pascal (MPa) (16). Shock wave therapy can use focal shock waves (ESWT) or radial shock waves (RSWT). An interface is placed between the shock wave sources (focal or radial) and the therapeutic target, i.e. a bag filled with water or gel, which has the function of transmitting shock waves and of regulation depth of penetration. The penetrance of the focal shock waves reaches up to 6 centimeters; this depends not only on the thickness of the interface, but also on the energy of the shock wave. In focal shock waves, the sound waves produced by the various sources converge at a central point called the focus (spot) in which the maximum pressure energy is determined; it represents the therapeutic "zone". In ESWT, shock wave therapy devices are generated by various types of systems; the most common are those of electro-hydraulic, electromagnetic and piezoelectric type. In RSWT, the radial shock waves are generated ballistically by a pneumatic system that accelerates a bullet towards an emission head at high speed, transforming the kinetic energy into pressure pulses. Unlike focused shock waves, with this system the focus is localized on the emission head and the acoustic waves are radially (spherical) spread over the target area, with rapid pressure dispersion and a large treatment volume (16).The effects of shock waves are mechanical and are divided into direct and indirect effects. The direct mechanical effects are essentially due to the positive pressure peak of the sound wave; they occur exclusively at the interface between tissues that have a different impedance, for example soft tissues and mineralized tissues. The indirect effects are instead due to the phenomenon of cavitation, that is to the formation of gaseous bubbles within the tissues: these gaseous bubbles undergo rupture (implosion phenomenon) producing high-speed micro-jets of water (jet streams) and great mechanical energy (16). Some studies have also highlighted biochemical effects related to the phenomenon of cavitation (17-19), characterized by the production of free radicals and above all nitric oxide, with cytolytic, vasodilating and neo-angiogenetic action. RSWT is so indicated in the treatment of insertional tendinopathies, with or without calcifications, and in myofascial pain syndromes with the presence of painful points (trigger points and tender points). Recent works suggest that RSWT can reduce the hypertonicity of patients suffering from cerebral palsy (20,21) and stroke (22). Contraindications are the presence of a pacemaker, the intake of corticosteroid or anticoagulant therapy, the proximity to the area to be treated of sensitive areas of the body such as the brain, the spinal cord, the gonads, the cartilages of growth, potentially risky physical states such as pregnancy, infections, neoplasms, coagulopathies, thrombophlebitis, etc. Among the side effects we mention the possible formation of hematomas, petechiae, exacerbations of pain and local analgesia which, however, are reversible phenomena (16). In literature, the presence of numerous studies conducted in order to test the effectiveness of the treatment with focal and / or radial shock waves of spasticity, as a result of stroke or PCI, is noted. Since 1997, ESWT has been considered useful in the treatment of muscular hypertonia and dystonia. RSWT has also recently been used successfully to treat muscle hypertonia. The most likely mechanism of action is a direct effect of the shock waves on muscle fibrosis and other non-reflected components of muscle hypertonia. In 2011, Vidal et al. (21) evaluated the effectiveness of 3 RSWT sessions (1 session per week; intensity: 2 Bar; 2000 strokes for each muscle treated) in 15 patients with cerebral palsy. RSWT was delivered using a Swiss Dolorclast device (EMS-Switzerland). The study focused on 40 hypertonic muscles (elbow and wrist flexors; hip adductors; soleus and hamstring), which were divided into 3 groups. In group I (14 muscles), RSWT was targeted only on hypertonic muscles; in group II (13 muscles), RSWT was delivered to hypertonic muscles and their antagonists; in group III (13 muscles), a placebo stimulation was applied to the hypertonic muscles. The characteristics of the placebo stimulation have not been specified. To evaluate the effect of the therapy, muscle hypertonia measured with MAS was assessed in the upper limbs; for the musculature of the lower limbs, on the other hand, the passive joint excursion (ROM) was taken into consideration as a result index. Patients were evaluated just before treatment and subsequently: 1, 2 and 3 months after the last session. One month after RSWT, MAS values deccreased for group I muscles and ROM values increased in both group I and group II muscles. No difference was found between group I and group II muscles, and no change was found following placebo stimulation. The results were maintained in the 2 months following the last RSWT session, while 3 months later they were no longer present. No side effects have been reported (20). In 2013, Gonkova et al. used a single session of RSWT to treat the ankle extensor muscles in 25 children with infantile cerebral palsy (intensity: 1.5 Bar; 1500 strokes for each of the 3 muscles that make up the triceps of the sura) 32. 40 ankle extensor muscles were treated using a BTL-5000 device (BTL Columbia, South Carolina, USA). The outcome indices were muscle tone assessment (MAS), ROM and baropodometric assessment. MAS and ROM values were recorded before RSWT, immediately after RSWT, 2 weeks and 4 weeks after RSWT. Baropodometric assessment was performed before and immediately after RSWT. Each subject was treated first with placebo stimulation and, a month later, with shock waves. For the placebo treatment, pads were placed between the applicator and the patient's skin and 100 strokes were delivered with the lowest intensity. After RSWT, no physiotherapy

treatment was performed for the next 4 weeks. The results show that the reduction in MAS values and the increase in ROM values occurred immediately after RSWT and lasted 4 weeks. The baropodometric evaluation revealed an increase in the pressure peak below the heel and an increase in the contact area of the feet after RSWT. There was no effect with the placebo stimulation. The authors state that RSWT was "well tolerated"; no other comments on possible side effects to treatment were reported in the study (20). In 2013, Kim and collaborators performed a study: "*Radial shock wave therapy (RSWT) in the treatment of muscle hypertonicity in stroke patients: a study conducted on the upper limb"* using 5 sessions of RSWT (1 session every 2 or 3 days; intensity: 1.6 Bar; 3000 strokes per session) in an uncontrolled trial in order to to treat the subscapularis muscle in 57 stroke patients (22). A Masterplus MP 200 device (Storz Medical AG, Tagerwillen, Switzerland) was used. The result indices were the ROM in the external rotation of the shoulder and the hypertonus of the external rotator muscles of the shoulder (MAS). Patients were evaluated at the beginning of each session (5 times) and once a week after the last session for a total of 6 weeks (6 times). During the study period, patients received physiotherapy treatments. During the 5 sessions of RSWT and the subsequent 4 weeks, the authors noted a reduction in hypertonus. The effects began to subside 4 weeks after the last session. No side effects were found during the study period (22)

C. CLINICAL REPORT

Fig. 1: the image shows a clinical picture of cervical dystonia.

In this presentation, a part of the paravertebral muscle group (m. Splenium and semispinal) on the right (1) can act as "dystonic muscles"; the top of the m. left trapezius (2), passively stretched by the anomalous movement, can be considered as an "antagonist muscle"; finally, the levator muscle of the right scapula (3) is a compensatory muscle, in fact the elevation of the right shoulder helps the patient in correcting his gaze.

Case Report

Ms. C.S., aged 57 was first time seen in 2011 at our clinic for treatment with botulinum toxin, at the age of 48. The patient reported childhood-onset generalized dystonia (11-13 months of age) with negative brain MRI. In the past she has taken therapy with L-Dopa, tetrabenzaine and baclofen without benefit. The neurologist consultant classified the Dystonia as primary generalized (DYT-1) and after 1 year she underwent Gpi-DBS surgery with unsatisfactory control of the dystonic picture. Months after the operation, she complained of worsening of the clinical picture, especially at the cranial-cervical level with disastrophony and dysphagia. The DBS parameters were: left1 (-), 120us, 130Hz, 2.4 mA and Right 9 (-). 150us, 80Hz, 2.3 mA (the patient independently changed the stimulation program from inactive to active and vice versa using the remote control which is doped in case of persistent worsening of the dystonic picture).

The clinical examination almost unchanged over the years was characterized by a more evident generalized dystonia picture at the cranial level with oro-mandibular dystonia, dysarthria, dysphonia, right retro-lateral neck (words difficult to understand); axial trunk dystonia, respiratory dystonia; segmental mobile dystonia mainly in the upper limbs with unsatisfactory control mainly for the axial component of the dystonia (fig.1) . . In the last decade patient continuing to suffer from cervical torsion dystonia on a genetic basis treated with slight results by DBS since several years; her clinical picture was characterised by a retro-neck with minimal right rotation (as shown in the image fig. She, often if not always, complains of painful retronucal and cervical tension mainly at night associated with right brachialgia and therefore treated for her neck and dorsal (Trapezius muscle) pain with RSWT using a Swiss Dolorclast device (fig.2). She is actually under 3-4 monthly botulinum toxin treatments since years. In the last 3 years the patient underwent ultrasound-guided focal treatment with Onabotulinum (Botulinum Toxin type A - BoNT-A) on the following muscles and with relative dosage Upper right trapezium.50 U - 2 points Upper left trapezium. 25 U - 2 points Right semispinal. and left. 25 U per side Splenium of the right neck. and left. 25 U per side Sternocleidomastoid (exclusively) right. 25 U - upper third Total: 200 U Onabotulinum. In our experience (30) Ultrasound guidance offers many benefits and allows you to visualize the spread of drugs guaranteeing a precise identification of muscles, with differentiation from adjacent structures (vessels, nerves, periosteum); an improvement of the infiltration technique thanks to constant visual feed-bac and possibility of recording the infiltration itself. In the recent past, the patient had undergone DBS (Deep Brain Stimulation), surgical treatment aimed at reducing the debilitating motor symptoms characteristic of movement disorders such as Parkinson's disease, essential tremor, dystonia, chronic pain (some forms) , obsessive-compulsive

disorders and major depression. The treatmentwas characterized by the implantation of a deep intracerebral lead, connected with a subcutaneous thoracic neurostimulator by means of a subcutaneous extension. (ref DBS) DBS does not affect treatment with botulinum toxin (23).

Fig.2 SWISS DOLORCLAST® MASTER device (EMS Electro Medical Systems

Outcome measures

The diagnosis of cervical dystonia is still based on the clinical evaluation of movement and dystonic posture.and the most widely used scales in the clinical setting for assessing spasmodic torticollis are the Tsui score and the Toronto Western Spasmodic Torticollis Rating Scale (TWSTRS) (ref). VAS and NRS scales, typically used for pain measurement, provided additional information. The VAS (Visual Analogical Scale) is made up of a 10 cm straight line with two ends that correspond to "no pain" and "maximum possible pain" (or the maximum experienced). It is a one-dimensional tool that quantifies what the patient subjectively perceives as pain or as relief in the complex of his physical, psychological and spiritual variables without distinguishing which of these components have a greater role. The NRS is a numerical scale from 0 to 10 in which 0 corresponds to the absence of pain and 10 the maximum imaginable pain.

D. Dystonia is an increase in muscle tone, which can be disabling and generate a continuous contraction; therefore it is also useful, in the context of clinical evaluation, to determine the degree of intrinsic hypertonia present in our patient. The most commonly used method is that of measuring the increase in tone through clinical scales such as the MAS scale (modified Ashworth scale) (24). The Ashworth 1964 scale, modified in 1987 by Bohannon (MAS), is an ordinal scale and allows you to evaluate muscular resistance to passive movement. The execution of this test requires that the patient is in supine decubitus and that the transition from the position of maximum flexion to that of maximum extension and / or vice versa of the joint must last for more than a second. The evaluation is carried out by passively mobilizing the segment to be tested and revealing the degree of resistance produced. It is applied to different muscle areas such as the flexors and extensors of the neck, elbow, wrist, hip and knee, the abductors and adductors of the hip, the dorsiflexors and plantaflexors of the ankle and foot.

E. The MAS scale is an ordinal scale (Tab. 2).

Tab. 2: MAS Score	
0	No increase in muscle tone
1	Slight increase in tone with block of less than 50% of the range of motion
1+	Slight increase in tone with block of less than 50% of the range of motion
2	Modest increase in muscle tone, with block greater than 50% with full ROM
3	Significant increase in muscle tone, ROM still complete or extremely difficult and with considerable use of time
4	Rigid segment in flexion or extension

It is a good clinical tool especially for repeated measurements by the same operator, but it has several limitations because it is an employee operator, there is poor interrater reliability and is not very sensitive.The aim of the report is to clinically investigate the role of RSWT in the treatment of cervical dystonia, on the hypertonus of the neck extensor muscles and on the pain of passive mobilization of the same.The main result indicator (primary outcome) is cervical pain (area undergoing treatment). Pain was measured using the VAS for pain. The secondary result indicator (secondary outcome) is the muscle tone of the neck extensors (upper trapezius, sternocleidomastoid, splenium of the neck, semispinal of the neck), measured in the supine position using the MAS. Other parameters analyzed are the amplitude and duration of involuntary movements of the neck, the elevation of the shoulder and the presence of tremor, evaluated through the Tsui scale.

F. Radial shock wave therapy (RSWT) protocol

G. The patient was treated bilaterally. Five treatment sessions were administered, with a 4-day interval between one session and another. During each session, 2000 strokes were administered in the extensor muscles of the neck distributed as follows: 1000 strokes for the upper trapezius muscle distributed bilaterally, 150 strokes for the right semispinal muscle, 150 strokes for the left semispinal muscle, 200 strokes for the muscle spelnio of the right head, 200 strokes for the splenius muscle of the left head and 200 strokes for the right sternocleidomastoid. The frequency used was 10 Hz, with a pressure of 2 bar. The treatment was not painful.The SWISS DOLORCLAST® MASTER device (EMS Electro Medical Systems SA) was used (Tab. 3).

Tab. 3:Technical specifications	
Frequency range	1-20 Hz (increments 1 Hz)
Air pressure range	1.5 - 4 bar (increments 0.1 bar)
Pulse range	500-10000 (500-pulse increments)
Energy emission	Positive Energy Density EVO BLUE 15 mm: Up to 0.18mJ / mm2 | 15mm focus: Up to 0.28mJ / mm2 Power + 15mm: Up to 0.4 mJ / mm2 15mm | focus: Up to 0.55 mJ / mm²

H. The evaluation was performed: before the initial treatment session (T0), after the first session (T1), at the end of each subsequent treatment session (T2, T3, T4, T5). The Tsui dystonia score scale was administered only in correspondence with the first and last evaluation (T0; T5) (Table 5).

The table (Tab. 4) shows the scores of the two result indicators obtained at the controls carried out immediately before the initial treatment session (T0), at the end of the first treatment session (T1) and after each other session (T2-T5) : 5 in total.

Tab. 4: Time trend of the result indices (VAS, MAS)		
	VAS score	MAS score
T0	8	3
T1	7	3
T2	3	3
T3	3	3
T4	1	3
T5	0	3

Tab. 5: Time course of Tsui's score	
	Tsui score
T0	16
T1	16

The "Treatment Effectiveness" parameter was used as a measure of residual disability for the primary outcome (PainVAS). Effectiveness is the benefit produced by the treatment administered in daily clinical practice (Table 6) (25). It is calculated according to the following formula:

Effectiveness = [Discharge Scale score] / [Initial Scale score - Maximum Scale score] X 100.

According to the formula, the effectiveness is 100% when the patient reaches the maximum improvement score of the scale.

Tab. 6: Treatment Effectiveness						
	T0	T1	T2	T3	T4	T5
VAS in	8	/	/	/	/	/
VAS out	/	7	3	3	1	0
Efficacia		12,5%	62,5%	62,5%	87,5%	100%

Furthermore, the "Efficiency" parameter was calculated as the rate of pain improvement per day (the average daily improvement during rehabilitation treatment), obtained as follows:

Efficiency = [Discharge Scale score - Initial Scale score] / [Days of Treatment] = 1.6.

Discussion

The main finding of this case report was that the 5 sessions of RSWT induced a significant reduction in pain. The peak of this reduction was recorded after the last treatment session (T5). Pain relief was noted at the end of each treatment administered (T1-T5). The acute painful symptomatology was reduced already at the first session, and then reappeared about 48 hours later. The patient generally returned to the next session with pain of much reduced intensity and more tolerated than at the start of treatment. RSWT had no documented influence on muscle hypertonus.

The radial shock waves reach a depth of action ranging from 2 to 3 cm36. The mechanism of action that these seem to have on pain is still the subject of scientific study and deepening. Compared to focused shock waves which have a direct action on the transmission mechanism of nociceptive fibers by molecular and biochemical processes, RSWT has been hypothesized to have a counter-irritation and pain modulation effect through GABAergic interneurons located in the posterior horns. spinal cord. Furthermore, the pressure and vibratory effect of the shock waves is effective in determining muscle decontracting and relaxation, (Travell and Rinzler in 1952 stated that muscle oscillations from 15 to 30 Hz cause relaxation and consequent muscle lengthening)(26). Finally, radial shock waves have a direct action on the reduction of local ischemia and local vaso-neuro-active substances, both responsible for pain, thus favoring blood and lymphatic hyperfusion of the treated tissues and local angioneogenesis (27,28) .All these direct and indirect mechanisms of action of the shock waves on the irradiated tissues are responsible for the immediate therapeutic efficacy that can be clinically verified, which is expressed with the decrease in muscle tension and functional recovery, the elimination of pain, the restoration of impaired attitude and postural balance (29).

Conclusion

I. In their recent experience (15) Abruzzese et al. reported that Extracorporeal shock wave therapy was probably an effective and safe treatment for upper limb dystonia, particularly for the secondary forms albeit they concluded that larger randomized studies are needed to confirm their preliminary results. According few previous reports on focal and radial shock waves on spasticity, we administered ESW in several moviment disorders reporting scarse and short lasting effects on t hypertonus, although our evaluations were always simply clinical and therefore

requiring at least a a larger cohort with studies on reflex H and wave F in order to try to to evaluate any imperceptible neurophysiological variations. However we always reported a self-patient decreased pain score at the end of each treatment administered. The patient generally returned to the next session with pain of reduced intensity and more tolerable than at the beginning of treatment albeit. The take home message hera is that RSWT had no clear useful influence on muscle hypertonia but reduce minimal head intentional tremors and often painful myalgia.

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