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THE IMPORTANCE OF RECOVERY TREATMENT IN PATIENTS WITH ALGONEURODYSTROPHY

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ABSTRACT. Introduction: AND (Algoneurodystrophy) is a neuropathic pain disease characterized by incapacitating pain, swelling, vasomotor instability, sudomotor abnormality, and impaired motor function. The pain is disproportionate to the severity of the tissue injury and lasts longer than the expected time for tissue repair. **Material and method:** The current study began with the idea that, in the case of algoneurodystrophy, patients in the experiment group would benefit from a considerably faster recovery in terms of mobility and coordination joints in hand and foot if a psychokinetic program, rather than only pharmacological treatment, was implemented. The program applied includes physiotherapy, massage, light range of motion of the affected limb, strengthening exercises, stress loading of the active part, if necessary, and ensuring adequate analgesia. As a result, this type of therapy encourages AND patients to use the affected limb in daily activities. **Results:** The experiment group followed the recovery protocol developed by us and achieved excellent results at the end of the week; the patients felt much better and were satisfied. The control group with drug treatment did not have a high degree of pain, but the joint mobility was affected, and the coordination did not improve much compared to the experiment group. After diagnosing algoneurodystrophy, immediate psychokinetic recovery is of considerable importance on the lost function of the hand and foot. **Conclusion:** The combination of kinetic treatment with physiotherapy next to drug treatment has beneficial effects on the recovery process in relieving pain and inflammation.

Key words: *recovery treatment, kinesiotherapy, algoneurodystrophy.*

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REZUMAT. ***Importanța tratamentului de recuperare la bolnavii cu algoneurodistrofie.*** **Introducere:** AND (Algoneurodistrofia) este o boală de durere neuropatică caracterizată prin durere, incapacitante, umflare, instabilitate vasomotorie, anomalie sudomotorie şi afectare a funcţiei motorii. Durerea este disproporţionată cu severitatea leziunii tisulare şi durează mai mult decât timpul estimat pentru repararea ţesuturilor. **Material şi metodă:** Actualul studiu a pornit de la ideea că, în cazul algoneurodistrofiei, pacienţii din grupul experiment ar beneficia de o recuperare considerabil mai rapidă în ceea ce priveşte mobilitatea şi coordonarea articulaţiilor la mâini şi picior dacă ar fi urmat un program fiziokinetic, mai degrabă decât doar un tratament farmacologic. Programul aplicat include kinetoterapie, masaj, amplitudine uşoară de mişcare a membrului afectat, exerciţii de întărire, încărcare la stres a părţii active, dacă este necesar, şi asigurarea analgeziei adecvate. Drept urmare, acest tip de terapie încurajează pacienţii AND să folosească membrul afectat în activităţile zilnice. **Rezultate:** Grupul experiment a urmat protocolul de recuperare elaborat de noi şi a obţinut rezultate excelente la sfârşitul săptămânii; pacienţii s-au simţit mult mai bine şi au fost mulţumiţi. Grupul control cu tratament medicamentos nu a avut un grad ridicat de durere, dar mobilitatea articulară a fost afectată, iar coordonarea nu s-a îmbunătăţit mult în comparaţie cu grupul experiment. După diagnosticarea algoneurodistrofiei, recuperarea fiziokinetică imediată are o importanţă considerabilă asupra funcţiei pierdute a mâinii şi piciorului. **Concluzii:** Combinaţia tratamentului kinetic cu kinetoterapie alături de tratamentul medicamentos are efecte benefice asupra procesului de recuperare în ameliorarea durerii şi a inflamaţiei.

Cuvinte cheie: *tratament de recuperare, kinetoterapie, algoneurodistrofie.*

Introduction

Algoneurodystrophy (AND) is a life-changing condition that usually affects the extremities after trauma or nerve damage (Shim et al., 2019).

Algoneurodystrophy (AND) may be a neuropathic torment clutter characterized by the nearness of particular clinical highlights, counting hyperalgesia, sudomotor and vasomotor variations from the norm, and trophic changes. The torment experienced is unbalanced depending on the degree of tissue harm and endures past the expected time anticipated for tissue mending (Guthmiller & Varacallo, 2020).

This syndrome is known by several different names, including reflex sympathetic dystrophy, causalgia, algodystrophy, Sudeck's atrophy, neurodystrophy, and post-traumatic dystrophy.

Algoneurodystrophy (AND) is caused by different degrees or types of tissue damage, but it has also been observed in the absence of injury or during periods of protracted immobility. The most typical lesion associated with AND

development is a fracture that occurs in> 40%. Other frequently inciting injuries include sprains, contusions, crushing injuries, and surgery (Guthmiller & Varacallo, 2020).

The pathogenesis of this disorder is nary still conclusive. Then, we accept Leriche's hypothesis, which considers that, in some cases, trauma will cause vegetative reflex, accompanied by the escape of local vasomotor control, followed by the installation of vasoconstriction, passive hyperemia, which is the basic process for subsequent changes in the area. Congestion may explain osteoporosis and soft-tissue edema but may not explain enough pain or atrophy (Marinus et al., 2011).

AND affects about 26 out of 100,000 people. It is more prevalent in women than in males, with a ratio of 3.5: 1. DNA can affect people of all ages, including children up to three years old and adults up to 75 years old, but it is usually the most common in the mid-thirties. Type I AND occurs in 5% of all traumatic injuries and 91% of all DNA cases after surgery (Turner-Stokes & Goebel, 2011), (Goebel, 2011).

The IASP (International Association for the Study of Pain) has classified CRPS into two types based on nerve damage sustained due to the injury.

• Type I: sympathetic reflex dystrophy (SRD), Sudeck's atrophy, RND (reflex neurovascular dystrophy), or algoneurodystrophy, sees no demonstrable nerve damage.

• Type II: also known as causal, has apparent nerve damage (Bruehl, 2015).

The medical evolution of the condition can usually be divided into three clinical phases: a warm early intense phase, with tendentious symptoms, occasionally proceeded by a dystrophic period distinguished by an enlightened decrease in edema. Then there is an atrophic phase, in which atrophy and skin contractions become predominant.

1. Stage: Usually, the initial symptoms appear within a few weeks of injury. The affected limb is extremely painful, erythematous, swollen, and warm in the painful period. Allodynia and hyperalgesia are common side effects, skin and nail growth changes, and muscle weakness. The affected area is limited and has no specific nerve distribution (Giannotti et al., 2016).

2. Stage: This stage usually lasts between 3 and 6 months, during which the symptoms progress. The skin continues to change, and it becomes thin, pale, shiny, and transparent; as a result, the nails become brittle and damaged. The intensity of the discomfort rises, and hair growth slows. The muscles weaken, and the joints tighten.

3. Stage: If the DNA remains untreated until this point, it becomes difficult or too painful for the patient to move the affected limb. This causes the muscles and tendons to dissipate (atrophy) and contract, which can eventually cause contractions of the affected hand or foot. These changes can become permanent (Goh et al., 2017).

Moreover, it can be installed in patients with associated risk factors, such as diabetes, dyslipidemia, neurovegetative dystonia, and alcoholism.

The conditions that a complex clinical analysis must eliminate in each case are deep vein thrombosis and thrombophlebitis; incorrect plaster casts and splints; carpal tunnel syndrome; the actual injuries; Gillian Barre Syndrome; peripheral atherosclerotic disease (Guthmiller & Varacallo, 2020).

The paraclinical investigation required is radiography, osteoden-sitometry (DEXA); electromyography; bone scintigraphy; contrast-enhanced MRI examination.

NSAIDs (non-steroidal anti-inflammatory drugs) have been used to treat pain and inflammation. The comprehensive treatment uses a multidisciplinary approach, the most important of which is the rehabilitation program. It is prudent to establish aggressive management as soon as possible, as a delay can led to an unfavorable outcome. Treatment should begin as soon as the diagnosis is confirmed. This involves the participation of an interdisciplinary team related to the evolutionary stage (Uritis et al., 2018).

Patients need to be educated to maintain a normal lifestyle without paying attention to recent trauma or surgical events. On the other hand, patients must follow an adequate nutritional plan. Avoid excessive intake of calories, alcohol, and excessive consumption of spices. Pain relief through medication, psychological counselling, and effort therapy is the primary goal of the first stage of evolution (Harden et al., 2013).

Conservative treatment is preferred through adequate initial mobilization (even assisted) and exercise programs to facilitate movement. Physical therapy applies low-frequency and medium-frequency currents (anti-inflammatory effects) for analgesic purposes. High-frequency currents, such as ultrasound with anti-edematous and fibrinolytic effects, skin desensitization by tactile stimulation, and thermal and hydrothermal therapy (Bruehl, 2015).

Recovery objectives: pain reduction; reduction of inflammatory phenomena; reduction of vasomotor and trophic disorders; functional re-education regarding the deficit of mobility of the different joints, the lack of coordination, and the global deficits regarding the grip or gait.

Electrotherapy procedures are beneficial for the direct influence of some symptoms in the clinical picture of AND and for shortening the period in which functional re-education can begin (Berger, 1999).

It includes a series of movement techniques, including analytical aspects and complex integration exercises that are indicated in the recovery of the grip or the re-education of gait. Movement exercises are prescribed after an analytical muscle and joint evaluation. Mobilization exercises are of different types: passive, passive-active, active-assisted, active, and active with resistance (Gutiérrez-Espinoza et al., 2019).

Material and method

The hypothesis of the research

In the present research, we started from the hypothesis that, in the case of algoneurodystrophy, if a psychokinetic program is applied, not only drug treatment itself, patients in the experiment group will benefit from a much faster recovery in terms of mobility, coordination joints in hand and foot.

The present research included 12 patients diagnosed with AND. A total of 6 patients underwent drug treatment, and six patients followed a psychokinetic recovery protocol.

The inclusion criteria were the following: medical diagnosis being algoneurodystrophy at the level of the hand or the level of the foot; proposed by the doctor to follow kinetic recovery sessions / drug; the age of patients between 30 and 75 years; patient agreed to participate in this study; symptoms: pain; swelling of the limb; colour change in the skin; vasomotor disorders; decreased mobility.

The exclusion criteria were the following: medical diagnosis being algoneurodystrophy in the shoulder or knee; the age of patients under 18 years; without the consent of patients to participate in this study.

Subjects of the research

The research subjects were 12 patients diagnosed with AND (Table 1); the control group was six patients that followed the traditional drug treatment, and the experiment group was six patients that followed the physio-kinetic program.

Table 1. Subjects of the research

No. Crt.	Subject	Age	Gender	Diagnosis	Control / Experiment group
1	Subject 1	48	Male	Right hand—AND post-traumatic	EG
2	Subject 2	59	Female	Right-hand post-traumatic—operator AND	CG
3	Subject 3	40	Male	Right hand—postoperative AND	CG
4	Subject 4	39	Male	Right leg—post-traumatic AND	CG
5	Subject 5	53	Female	Right hand—Post-traumatic AND—Tenosynovitis	EG
6	Subject 6	72	Male	Left leg—post-traumatic AND—after fracture	CG
7	Subject 7	50	Female	Left hand—post-traumatic AND—after fracture	EG
8	Subject 8	32	Male	Right leg—post-traumatic AND—after fracture	EG
9	Subject 9	69	Female	Right hand—post-traumatic AND	EG
10	Subject 10	62	Female	Left hand—post-traumatic AND—after fracture	CG
11	Subject 11	51	Male	Left leg—post-traumatic AND—after fracture	EG
12	Subject 12	63	Female	Right leg—post-traumatic AND—after fracture	CG

Methods of research used

• Joint balance. In the strict sense, the articular balance represents the measurement of the amplitudes of movement in the joints in all directions of movement. Goniometers are regarded as valid and dependable clinical tools for determining the range of motion of limb joints (Tavares et al., 2017).

However, the correct execution of the measurements requires experience after repeated tests. It refers to the appreciation of the actual maximum limit of a movement, especially in people who do not cooperate or have pain when mobilizing when approaching the angle. Depending on their function and purpose, the measurements shall be specified. In the case of measurements used in studies and research, errors above 3° are not permitted (Sbenghe, 2019).

Goniometers are commonly used in clinical practice, and goniometric measurement can be regarded as a gold standard. Goniometry appears to be the foremost objective, a solid strategy accessible to clinicians for assessing a standard ROM (Ellis & Bruton, 1998).

• VAS scale. The visual analogue scale (VAS) comprises a successive route through endpoints that characterize extraordinary limits, such as “no torment at all” and “pain as awful because it might be” (Haefeli & Elfering, 2006). The quiet

is inquired to check his torment level on the route among the two destinations. The removal between "painless" and the sign at that point characterizes the subject's pain. This instrument was, to begin with, utilized in Freyd's brain research in 1923 (Freyd, 1923). On the off chance that clear terms such as "mild", "moderate", "severe," or a numerical scale are included in the VAS, it is called a Realistic Appraisal Scale. (GRS). A-line length of 10 or 15 cm appeared to be the scarcest estimation mistake compared to the 5 and 20 cm adaptations and appeared to be the foremost helpful for respondents (Seymour et al., 1985).

The advantages and disadvantages of measuring the effect of pain by VAS are similar to assessing pain intensity. The terms that define the objectives of the scale could be, for example, "not bad at all" and "the most unpleasant feeling possible". In several investigations, the VAS for evaluating torment impedance has appeared to be substantial and delicate to treatment impacts and the qualities of the reporting scale (Von Korff et al., 2000).

Score:

0— No pain; **3**— Irritation enough to distract; **5**— Pain should not be ignored for longer than 30 minutes; **7**— Very intense pain; **10**— Unbearable pain.

The International Association for the Study of Pain defines pain as "... an unsavoury tactile and enthusiastic encounter that's related with genuine or potential tissue harm or portrayed in such terms." This definition proceeds: "Pain is continuously subjective. Every person learns how to use the word in different contexts through experiences of injury in early life." (Cohen et al., 2018).

Place of the Research

The research took place between November 2020 and April 2021, at Fizio—Kineto Centrum in Odorheiu Secuiesc. Each subject engaging in the investigation was followed for two weeks.

Recovery Program Developed and Implemented

The program includes physiotherapy, massage, light range of motion of the affected limb, strengthening exercises, and stress loading of the active part, if necessary, together with ensuring adequate analgesia. As a result, this therapy encourages AND patients to use the damaged limb in daily activities.

The recovery program included physiotherapy (ultrasonic, galvanic bath, laser therapy), therapeutic massage, and kinesitherapy.

Results

The research used the VAS examination scale (Table 2, Table 3) and Goniometry—Carpal / tarsal flexion—Dorsiflexion assessment scale (Table 4, Table 5, Table 6, and Table 7). The test was taken in the first week at the beginning of the study and in the second week at the finalization of the second week of treatment.

Table 2. The experiment group at the VAS examination scale

No.	Subject	Gender	Member diagnosed with AND	Week I	Week II
1.	Subject 1	Male	Right hand	8	2
2.	Subject 2	Female	Right hand	10	4
3.	Subject 3	Male	Right foot	7	3
4.	Subject 4	Female	Left hand	9	2
5.	Subject 5	Female	Right hand	9	4
6.	Subject 6	Male	Left foot	7	3

Table 3. The control group at the VAS examination scale

No.	Subject	Gender	Member diagnosed with AND	Week I	Week II
1.	Subject 1	Female	Left hand	8	6
2.	Subject 2	Female	Right hand	7	4
3.	Subject 3	Male	Right hand	9	6
4.	Subject 4	Male	Left foot	8	5
5.	Subject 5	Male	Right foot	7	5
6.	Subject 6	Female	Right foot	6	5

Table 4. The experiment group at the Goniometry—Carpal/tarsal flexion—Dorsiflexion examination scale

No.	Subject	Gender	Member diagnosed with AND	Week I	Week II	Normal value
1.	Subject 1	Male	Right hand	40°	66°	70°
2.	Subject 2	Female	Right hand	10°	63°	70°
3.	Subject 3	Male	Right foot	8°	20°	20°
4.	Subject 4	Female	Left hand	45°	70°	70°
5.	Subject 5	Female	Right hand	25°	65°	70°
6.	Subject 6	Male	Left foot	7°	18°	20°

Table 5. The control group at the Goniometry—Carpal/tarsal flexion—Dorsiflexion examination scale

No.	Subject	Gender	Member diagnosed with AND	Week I	Week II	Normal value
1.	Subject 1	Female	Left hand	20°	40°	70°
2.	Subject 2	Female	Right hand	34°	52°	70°
3.	Subject 3	Male	Right hand	17°	45°	70°
4.	Subject 4	Male	Left foot	5°	12°	20°
5.	Subject 5	Male	Right foot	8°	14°	20°
6.	Subject 6	Female	Right foot	7°	13°	20°

Table 6. The experiment group at the Goniometry—Metacarpophalangeal flexion/ metatarsophalangeal

No.	Subject	Gender	Member diagnosed with AND	Week I	Week II	Normal value
1.	Subject 1	Male	Right hand	20°	77°	90°
2.	Subject 2	Female	Right hand	30°	86°	90°
3.	Subject 3	Male	Right foot	22°	35°	35°
4.	Subject 4	Female	Left hand	28°	90°	90°
5.	Subject 5	Female	Right hand	55°	70°	90°
6.	Subject 6	Male	Left foot	30°	35°	35°

Table 7. The control group at the Goniometry—Metacarpophalangeal flexion/ metatarsophalangeal

No.	Subject	Gender	Member diagnosed with AND	Week I	Week II	Normal value
1.	Subject 1	Female	Left hand	30°	53°	90°
2.	Subject 2	Female	Right hand	40°	60°	90°
3.	Subject 3	Male	Right hand	20°	70°	90°
4.	Subject 4	Male	Left foot	14°	30°	35°
5.	Subject 5	Male	Right foot	20°	33°	35°
6.	Subject 6	Female	Right foot	30°	35°	35°

Statistical interpretation

Statistical analysis (Table 8) included descriptive statistics (frequency, mean, median, standard deviation) and inferential statistics. The Kolmogorov Smirnov test was applied to determine the distribution of the analyzed data series. For comparison of means, the t-Student test was applied, respectively

the Mann-Whitney test for comparison of medians. The significance threshold chosen for p was 0.05. Statistical analysis was performed using the GraphPad Prism utility trial version.

Table 8. The statistical interpretation of data

Statistical interpretation regarding age comparison	Experiment group vs. Control group Unpaired t-test P-value	0.4809
Statistical interpretation regarding VAS results in Week I	Experiment group vs. Control group. Unpaired t-test P-value	0.2314
Statistical interpretation regarding VAS results in Week II	Experiment group vs. Control group Unpaired t-test P-value	**0.0011**
Goniometry—Carpal tarsal flexion—Week I	Experiment group vs. Control group Unpaired t-test P-value	0.3934
Goniometry—Carpal tarsal flexion—Week II	Experiment group vs. Control group Unpaired t-test P-value	0.0649
Goniometry—Metacarpophalangeal flexion/ metatarsophalangeal—Week I	Experiment group vs. Control group Unpaired t-test P-value	0.5655
Goniometry—Metacarpophalangeal flexion/ metatarsophalangeal—Week II	Experiment group vs. Control group	0.1541

The t-Student test, p> 0.05, was used to discover any statistical differences between the median of the two groups regarding age parameters; there was no statistically significant difference between the mean age values in the two groups (p = 0.4809).

We used the t-Student test, p> 0.05, to discover the statistical differences between the median of the two groups regarding the results of the VAS scale first week; there was no statistically significant difference between the mean values of the VAS Scale—Week I in the two groups (p = 0.2314).

Also, it was used the t-Student test, p <0.05, to discover the statistical differences between the median of the two groups regarding the results of the VAS scale second week, there was found a statistically significant difference between the mean values of the VAS Scale—Week II in the two groups (p = 0.0011).

The t-Student test, p> 0.05, was used to discover any statistical differences between the median of the two groups regarding the results of the Goniometry; there is no statistically significant difference between the mean values Goniometry—Carpal/tarsal flexion—Week I in the two groups (0.3934).

We used the t-Student test, p> 0.05, to discover the statistical differences between the median of the two groups regarding the results of the Goniometry; there was no statistically significant difference between the mean values of the Goniometry—Carpal tarsal flexion—Week II in the two groups (p = 0.0649).

Also, it was used the t-Student test, p <0.05, was for discover the statistical differences between the median of the two groups regarding the results of the Goniometry, there was found no statistically significant difference between the mean values of the Goniometry—Metacarpophalangeal flexion / metatarsophalangeal—Week I (p = 0.5655).

The t-Student test, p> 0.05, was used to discover any statistical differences between the median of the two groups regarding the results of the Goniometry; there is no statistically significant difference between the mean values of Goniometry—Metacarpophalangeal flexion / metatarsophalangeal—Week II in the two groups (0.1541).

Discussions

In order to diagnose AND as soon as possible and treat it more effectively and precisely, it is essential to apply effective physical therapy, following the recovery protocol based on therapeutic exercises and appropriate physiotherapy. This leads to regaining early degrees of flexion, relieving pain, reducing edema, and achieving positive functional results.

Similar to our study, Gutiérrez-Espinoza et al. analyzed that an intense treatment strategy founded on hydrotherapy, manual therapy, and short-term exercise improves function and reduces pain in patients over 60 years of age with CRPS I after conservatively treated DRF. All patients performed a 15-minute active wrist exercise in a jacuzzi using a thermoneutral immersion in water (34.5 °C), which decreases sympathetic nervous system activity and the effects of hydrostatic pressure, which helps reduce edema and pain perception (Gutiérrez-Espinoza et al., 2019).

Wasner G. et al. recently presented a shift to functional skills reinstated rather than pain management as the primary objective of therapy. One of the essential components of this method is therapeutic exercise, despite some debate about whether a strenuous activity can be harmful early (Wasner et al., 2003).

In the other article, Barnhoorn K. J. et al. (Barnhoorn et al., 2015), treatment means working on joint developments, and inactive power developments are habitually unfortunate and agonizing and should be kept away from during the intense stage. The article indicates that inactive treatment, trailed by isometric and isotonic physiotherapy, should be possible when the aggravation level reductions (Birklein, 2018). In this manner, a multidisciplinary approach to the treatment of DNA patients ought to be considered, and the fundamental reason for pharmacological intercessions is to dispose of torment. Misidou, C., & Papagoras, C. believe that Physical Therapy is more effective in decreasing discomfort and enhancing proactive mobility (Misidou & Papagoras, 2019).

Birklein F et al., in the article Neurological findings in complex regional pain syndromes—analysis of 145 cases (Birklein et al., 2000) similar to ours, concluded that in the case of DNA is the existence of distal edema, which happens in 80% of all cases.

We would also like to emphasize the importance of the interdisciplinary part, namely the physical development (Szabo & Sopa, 2020), stress management (Popa et al., 2020), as well as everything related to the motor control part in the general physical recovery (Szabo et al., 2021).

Conclusions

The hypothesis of our study was confirmed, namely, in the case of algoneurodystrophy, if a psychokinetic program will be applied, not only drug treatment itself, patients in the experiment group benefited from a much faster recovery in terms of mobility and coordination joints in hand and foot.

The experiment group followed the recovery protocol developed by us and achieved outstanding results at the end of the week; the patients felt much better and were satisfied.

The control group with drug treatment did not have a high degree of pain, but the joint mobility was affected, and the coordination did not improve much compared to the experiment group.

Patients could not regain their hand function or resume walking through drug treatment, and physical therapy and physiotherapy are much more effective.

After diagnosing algoneurodystrophy, immediate psychokinetic recovery is of considerable importance to the lost function of the hand and foot.

The combination of kinetic treatment with physiotherapy next to drug treatment has beneficial effects on the recovery process in relieving pain and inflammation.

The treatment in algoneurodystrophy should include physiokinetotherapy over time because it has significant importance in the complete recovery next to the drug treatment. Also, the continuation of physiotherapy and occupational therapy after two weeks of recovery strengthens the recovery process and contributes to therapeutic exercises for the complete recovery of the damaged limb (hand or foot).

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