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Dog-assisted physiotherapy in amyotrophic lateral sclerosis: a randomized controlled pilot study

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Abstract

BACKGROUND

Animal-assisted therapy (AAT) is an intervention in which the animal acts as a co-therapist. It has been mainly used in the context of patients with dementia, showing positive effects on psychological symptoms, but its potential as a physiotherapy treatment for patients with neuromuscular disorders, amyotrophic lateral sclerosis (ALS) in particular, has not yet been investigated.

AIM

The aim of the study was to evaluate the impact of AAT, specifically of dog-assisted therapy, on motor functions and psychological status in patients with ALS.

DESIGN

This study was a randomized controlled pilot study.

SETTING

The study was carried out at the Rehabilitation Unit NEuroMuscular Omnicenter (NEMO) of Arenzano, Genoa.

POPULATION

Sixty hospitalized ALS patients were enrolled.

METHODS

All patients ran a regular two-weeks neurorehabilitation program twice a day. For three days a week, in place of the morning traditional treatment, the AAT group performed a rehabilitation session with a simultaneous interaction with the therapy-dog, while the control group performed a traditional rehabilitation session. The outcome measures were the Timed Up and Go Test, the Short Physical Performance Battery (SPPB), the Six Minutes Walk Test, the Ten Meters walking Test and the Hospital Anxiety and Depression Scale.

RESULTS

Both groups showed an amelioration in motor scales. However, SPPB subscales as well as HADS scores showed a statistically significant improvement only in the AAT group (P values from <0.0001 to 0.0004). Additionally, across almost all motor and psychological measures, post-treatments values were significantly better for the AAT group (P values from <0.0001 to 0.01).

CONCLUSIONS

The obtained results not only suggest that AAT is comparable to traditional physiotherapy treatments, but also evidence that this type of treatment has greater beneficial effects on motor and psychological symptoms in patients with ALS.

CLINICAL REHABILITATION IMPACT

This study provides first evidence that AAT is a powerful rehabilitation strategy in patients with ALS, improving both motor and psychological symptoms, and therefore possibly ameliorating quality of life.

Key words: Physical therapy modalities, Animal assisted therapy, Amyotrophic lateral sclerosis, Rehabilitation

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Amyotrophic lateral sclerosis (ALS) is a rapidly progressing, fatal neurodegenerative disease with largely unknown etiology.[1] The most frequent symptom at onset is a focal, asymmetrical weakness beginning in the upper or lower extremities or in the bulbar muscles. Muscle weakness is indeed considered as the cardinal clinical sign of ALS.[2]

Despite this, the effects of exercise on such patients are not yet well understood, and there are no clear indications regarding the best type and intensity of physiotherapy.[3] On the one hand, reducing physiotherapy may lead to cardiovascular deconditioning and atrophy from disuse, in addition to increasing weakness caused by the disease itself;[3, 4] on the other hand, excessive exercise or strengthening exercises may induce overwork damage.

In this context, recent works suggest to avoid high intensity exercises that can stress the fast muscle fibers (animal studies in particular have shown an earlier degeneration of fast muscles in ALS[5]) and rather propose exercises focused on the reduction of spasticity, on the strengthening of weak muscles and on the minimization of fatigue.[6] Low and moderate intensity aerobic exercises appear to be beneficial in muscle strengthening and cardiovascular exercise can help maintaining motor performance, preventing further deconditioning and muscle atrophy without adverse effects on disease progression. Recent studies have indeed demonstrated that resistance and endurance exercises are safe and have no negative effects on ALS progression.[7, 8]

Animal assisted interventions (AAI) can be classified as animal-assisted therapy (AAT), Animal-Assisted activities, and animal-assisted education. According to the International Association of Animal-Interaction Organizations (IAHAIO), Italian guidelines define AAT as a formal intervention, targeted for patients with specific diagnoses and with precise therapeutic objectives.[9, 10] The therapy-dog is the most used animal in AAT as a co-therapist and the rehabilitation program is coordinated by a multidisciplinary team.[11, 12] The positive helpful bond between the patient and the therapy-dog is the basis for an effective outcome of AAT. Recent studies indeed suggest that animal-to-human interaction results in positive “short-term” physical health effects for both species (*i.e.* increased oxytocin production, reduction of stress hormone levels, including epinephrine and norepinephrine, and reduction of cortisol levels).[13-16] Animals can act as transitional objects, allowing people to first establish a bond with them, and then promoting social interactions with other people. To date, AAT has been mainly used in the context of patients with

dementia,[17] showing positive effects on psychological and behavioral symptoms, while its potential as a physiotherapy treatment for patients with neuromuscular disorders, ALS in particular, has not yet been investigated.

The aim of the present study was therefore to evaluate the impact of dog-assisted therapy on motor functions and psychological status in patients with ALS.

Materials and methods

Study design

This randomized controlled pilot study was focused on patients with ALS. The study protocol was approved by the Regional Ethics Committee for Research and Trial in Genoa (CER Liguria n. 004/2018). All study procedures were run according to the Declaration of Helsinki.

Written informed consent was obtained from all participants before enrollment.

Participants

Eligible ALS patients were recruited at the Rehabilitation Unit NEuroMuscular Omnicentre (NEMO) of Arenzano from June 2018 to June 2019. The inclusion criteria were: 1) a diagnosis of possible, probable, probable laboratory-supported or definite ALS according to the El Escorial revised criteria;[18] 2) only mild disabilities of the lower limbs (Sinaki-Mulder stage I: "Ambulating without the use of an assistive device" and stage II: "Ambulating with the aid of an assistive device, such as walker, cane, or ankle-foot orthosis"[19, 20]) and the upper limbs (Medical Research Council scale [MRC]) Score ≥4); and 3) capability to understand and sign the informed consent for participating in the study. The exclusion criteria were: 1) any medical disorder that could interfere with physical activity, including active malignancy, severe heart, lung, renal and liver failure; 2) overt dementia; and 3) allergy to animals.

Allocation and blindness

A total of 60 patients with ALS were enrolled in the study. Based on the case-control principle, participants were assigned to either the AAT group or the control group, with matching criteria including age, gender and baseline Amyotrophic Lateral Sclerosis Functional Rating Scale revised (ALSFRS-R) scores. Each group comprised 30 patients. The outcome assessors and statistical analysts were both blinded to the allocation sequences. Independent therapists were appointed to measure the outcomes and were required not to participate in any training sessions. Unrelated codes, such as A and B, were used to represent the groups during the evaluation and statistical analyses.

Intervention procedure

All patients who participated in the study (AAT and control group) ran a regular neurorehabilitation program at the Rehabilitation Unit NEuroMuscular Omnicentre (NEMO) of Arenzano consisting in one hour session, twice a day, of: 1) passive stretching of the quadriceps, iliopsoas and posterior chain lower limbs muscles; 2) active mobilization balance training consisting in pelvis and trunk stability control exercises (seated or erect). Training was performed both in static (*i.e.* either balanced in an erected posture on a wobble force-plate or sitting on a Bobath ball) and dynamic conditions (*i.e.* walking in a corridor with obstacles); and 3) general muscle reinforcement and endurance exercise consisting of isotonic exercises (with or without resistance), isometric exercises and bicycle ergometer.

The overall duration of the training program was two weeks. All sessions were adapted to the fatigability and autonomy of each patient according to Borg rating of perceived exertion scale standard, and established to be interrupted if patients reported a score of 15 (hard exertion).

AAT group

In place of the morning traditional session, for three days a week, patients of the AAT group performed a rehabilitation session focusing on balance training with a simultaneous interaction with the therapy-dog.

Exercises of AAT were established by a team made up by a physiatrist as the project manager, physical therapists with eight years of experience working with ALS patients, an AAT-expert dog handler and veterinary surgeon, as well as two therapy dogs, according to the National Guidelines and IAHAIO. All participants of this group had a specific academic training in AAT.

Two Swiss White Shepherds, with advanced education training and possessing peculiar skills such as ability to relate emotionally and dynamically to the patient were selected. They were evaluated based on their skills, particularly docile character, empathic ability, body size, and color. All animals underwent a detailed clinical examination by their AAT-expert veterinary surgeon to ensure their health before the beginning of the study and therefore avoid the risk of transmissible diseases between them and patients. Therapy compliance, as well, was confirmed by the AAT expert veterinary surgeon. All therapy dogs passed a behavioral training prior to the study enrollment.

The therapy dog handler had prior experience in this type of activity and completed academic extensive AAI training. After each AAT session, the handler completed a self-reported form to indicate the activities that occurred and her dogs' behavior.

The AAT was performed by experienced physical therapists who, through the interaction of the patient with the therapy-dogs, always supervised by their handler, carried out the rehabilitation work. Physical therapists worked with each patient during the interaction with the therapy-dog. The balance rehabilitation training program consisted of the regular balance exercises (as detailed in the intervention procedure section) with simultaneous tasks in interaction with the therapy dog. In particular, during the balance exercises in static conditions, patients held a circle in equilibrium in which the therapy dog skipped or threw a game ball that the therapy dog had to retrieve, while during the balance exercises in dynamic conditions, patients had to simultaneously conduct the dog.

Control group

In place of the morning traditional treatment, for three days a week, patients in the control group performed a session of regular balance exercises (as detailed in the intervention procedure section) with simultaneous tasks in interaction with the physiotherapist. In particular, during the balance exercises in static conditions, patients passed a circle or threw a game ball to the therapist from different positions, while during the balance exercises in dynamic conditions, patients were walking in hand with the therapist who was triggering balance search.

Outcome measurements

Clinical outcome assessments of ALS patients were conducted at baseline and after the two-weeks treatment. In order to avoid any state of fatigue produced by the assessments, each test was performed with a 10-minutes time interval. The total duration of the evaluation was 60 minutes, including rest periods. Participants in Sinaki-Mulder Stages II performed each test with their assistive device.

A quantification of muscular weakness was obtained by manual muscle testing of all the extremities as defined by the MRC Scale score and disability was evaluated using the ALSFRS-R. The balance performance was assessed using the Short Physical Performance Battery (SPPB) and the Timed Up and Go (TUG) test.

The SPPB, a brief performance battery based on a timed short distance walk, repeated chair stands, and a set of balance tests – is a validated assessment tool for measuring lower extremity function that is widely used in both clinical and research settings. The SPPB index is the sum of three functional components: standing balance (SB), timed walking, and chair standing. Standing balance was assessed for 3 different static positions: feet side by side, semitandem (*i.e.* side of the heel of 1 foot touching the big toe of the other), and full tandem (heel of 1 foot in front of and touching the toes of the other foot). Participants were instructed to try to hold each of these positions for 10 seconds.[21]

The TUG test requires the patient to rise from a seated position, walk three meters, turn around, and return and sit in the starting point chair while timed. Patients who fail to complete the test in fewer than twelve seconds are considered to have elevated fall risk.[22]

Walking endurance was evaluated using the six minutes walk test (6MWT), a measure of the maximum distance covered by the patient during the available minutes.[23] Walking speed was evaluated using the ten meters (10M) walking test, a measure of the time needed by the patient to walk ten meters as quickly and safety as possible.[24]

Mood disorders, in particular anxiety and depression, were assessed using the Hospital Anxiety and Depression (HADS) scale, a questionnaire composed of two scales with seven questions each, assessing both anxiety and depressive symptoms.[25]

Statistical analysis

Shapiro-Wilk Tests were used to evaluate the normality of data distribution and the Levene Test was applied to assess the homogeneity of the variance. Accordingly, Student's *t*-tests, Wilcoxon Rank Sum Test and χ^2 Tests were used, as appropriate, to evaluate differences in demographic and baseline clinical features between the AAT and the control group.

To examine the effect of the AAT treatment, intragroup differences between baseline and post-treatment values were assessed in each group separately using a paired *t*-test and a Wilcoxon Signed Rank Test, as appropriate.

Finally, a one-way analysis of covariance (ANCOVA) was used to investigate differences between the AAT and control group in post-treatment values, using the baseline measurements as covariates. Significance was set at two-sided P value of 0.05. Analyses were conducted using SAS 9.3 (SAS Institute Inc., Cary, NC, USA).

Results

Baseline demographic and clinical features of the two groups are shown in Table I. The AAT group consisted of 30 patients, 10 females and 20 males, with a mean age of 65.66 years; in the control group there were 30 patients, 12 females and 18 males, with a mean age of 69.6 years. No statistically significant differences were observed between the two groups in terms of both demographic and baseline clinical features, except for the SB score which was significantly higher in control group (P=0.03).

Table I. —Demographic and clinical features of the control and AAT groups at baseline.

	Control group (N.=30)	**AAT group (N.=30)**	**P value**
Demographic features			
Age	69.6±9.25	65.66±9.83	0.1153
Sex, M	18 (60.00%)	20 (66.67%)	0.5951
Motor features			
ALSFRS-R	36.03±6.37	34.67±6.69	0.4210
SPPB	8.37±2.09	6.80±3.38	0.0694
Chair standing	2.83±0.91	2.40±1.16	0.1383
Timed Walking	2.67±1.15	2.40±1.16	0.3741
SB	2.87±0.73	2.13±1.36	0.0362
6MWT	257.50±114.02	244.90±136.60	0.6995
10M	14.02±4.98	16.03±7.59	0.4545
TUG	14.38±7.73	16.11±9.01	0.5883
Mood features			

	Control group (N.=30)	AAT group (N.=30)	P value
HADS total score	12.17±3.83	14.10±6.50	0.4044
HADS anxiety score	6.47±2.80	8.20±4.02	0.1280
HADS depression score	5.73±1.95	5.90±3.02	0.8626

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Values are given as means±standard deviations and absolute (percentage) frequencies. M: males; SPPB: Short Physical Performance Battery; SB: standing balance; 6MWT: Six Minute Walking Test; 10M: Ten Meter Walk Test; TUG: Time Up and Go; HADS: Hospital Anxiety and Depression Scale.

Paired *t*-test, Wilcoxon Signed Rank Test and ANCOVA analyses results are presented in Table II. Regarding intragroup differences in motor features, significant variations between baseline and post-treatment values were observed in both groups for all the investigated measures except for the chair standing, timed walking and SB scores, which showed a significant change only in the AAT group (P<0.0001, P=0.0004, and P<0.0001 respectively). As concerns mood measures, significant variations between baseline and post-treatment HADS total, anxiety and depression scores were selectively observed in the AAT group (P<0.0001).

Table II. —Intragroup differences between baseline and post-treatment values, and differences in post-treatment values between the two groups.

	Group	Baseline	Post-treatment	P value*	P value**
Motor features					
SPPB	AAT	6.80±3.38	9.07±3.06	<0.0001	<0.0001
	Control	8.37±2.09	8.70±2.04	0.0054	
Chair standing	AAT	2.40±1.16	2.93±1.08	<0.0001	0.0069
	Control	2.83±0.91	2.97±0.85	0.1250	
Timed walking	AAT	2.40±1.16	3.00±1.20	0.0004	0.0043
	Control	2.67±1.15	2.77±1.07	0.2500	
SB	AAT	2.13±1.36	3.13±1.04	<0.0001	0.0005
	Control	2.87±0.73	3.00±0.79	0.2180	
6MWT	AAT	244.90±136.60	326.67±118.88	<0.0001	0.0037
	Control	257.50±114.02	286.50±128.86	<0.0001	
10M	AAT	16.03±7.59	13.03±6.01	<0.0001	0.1925

	Group	Baseline	Post-treatment	P value*	P value**
	Control	14.02±4.98	12.80±4.10	0.0097	
TUG	AAT	16.11±9.01	12.18±7.11	0.0014	0.0083
	Control	14.38±7.73	13.00±6.03	<0.0001	
Mood features					
HADS total score	AAT	14.10±6.50	11.40±6.14	<1.0001	<0.0001
	Control	12.17±3.83	12.30±4.07	0.5926	
HADS anxiety score	AAT	8.20±4.02	6.47±3.83	<1.0001	0.0001
	Control	6.47±2.80	6.77±2.43	0.8756	
HADS depression score	AAT	5.90±3.02	4.93±2.68	<1.0001	0.0108
	Control	5.73±1.95	5.53±2.01	0.4453	

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Values are given as means±standard deviations. SPPB: Short Physical Performance Battery; SB: standing balance; 6MWT: Six Minute Walking Test; 10M: Ten Meter Walk Test; TUG: Time Up and Go; HADS: Hospital Anxiety and Depression Scale. *Paired *t*-test and Wilcoxon signed rank analysis results; **ANCOVA analysis results.

The ANCOVA analysis showed a statistically significant difference in post-treatment values between the two groups across all measures except for the 10M score, with the AAT group showing better motor and mood scores.

Discussion

To our knowledge, this is the first study investigating the possible beneficial effects of AAT, as compared to conventional physiotherapy treatment, in patients with ALS. The obtained results not only suggest that AAT is comparable to traditional physiotherapy treatments, but also evidence that this type of treatment has greater beneficial effects on motor and psychological symptoms in patients with ALS.

At baseline, the AAT and control groups were absolutely comparable across all the evaluated measures, except for the SB, in which the control group exhibited significantly higher values relative to the AAT group. Notably, however, the inclusion of baseline measurements as covariates in the statistical models has enabled to exclude a potential effect of such aspect on the obtained results.

As regards motor symptoms, while the comparison between pre- and post-treatment values showed a significant improvement of balance (evaluated through the TUG and total SPPB) in both groups, the more specific analysis of SPPB subscales (chair standing, timed walking, and SB) scores evidenced a significant improvement only in the AAT group.

Furthermore, across almost all motor measures, the comparison of post-treatment values between the two groups highlighted a significantly greater improvement of symptoms in the AAT group.

Notably, better post-treatment TUG scores suggest that AAT might be particularly useful for preventing falls in ALS patients.[26] In accordance with recent studies reporting beneficial effects of AAT on alertness and concentration,[27] it is plausible to hypothesize that the observed greater improvement in balance may have been favored by higher

concentration while performing exercises with the therapy-dog assistance. During the AAT sessions we indeed observed that the animals helped patients maintaining high attention levels for longer time periods, even if further studies are needed to objectively assess attention levels in neuromuscular patients treated with AAT.

Another important aspect to consider when interpreting the greater motor improvement, is the role of motivation. Previous reports in psychiatric and dementia populations, indeed, suggest that AAT increases motivation and self-esteem.[28] Accordingly, in our setting, we observed that the bond between the animal and the patient allowed to develop new rehabilitative strategies which were experienced as moments of meaningful interaction rather than just treatment techniques. During the therapy-dog assisted rehabilitation program, the physiotherapist applied the traditional rehabilitation techniques, however, the distinctive factor, favorable even from the motor point of view, was the commitment and spontaneity experienced by the patient while performing the tasks. Notably, the treatment performed with the therapy-dog integrates the traditional treatment provided during hospitalization, therefore it should be considered as a complementary, rather than a substitute strategy.

As regards psychological symptoms, we found that anxiety and depression levels (as evaluated using the HADS) were significantly reduced after treatment only in the AAT group.

This finding is in line with previous reports demonstrating a significant amelioration of mood symptoms after AAT in the elderly, as well as in patients with dementia.[28, 29] However, while in those studies AAT has been proven effective only on depressive symptoms, our study suggests that, in patients with ALS, this rehabilitation strategy is also beneficial on anxiety disturbances.

The observed improvement of mood symptoms is a key finding with important clinical implications. Firstly, it is well established that depression and anxiety symptoms significantly influence quality of life in patients with ALS.[30, 31] Secondly, even if not a predictor itself, emotional well-being has been found to be strongly associated with disease progression in ALS,[32] emphasizing the utility of rehabilitation programs ameliorating mood symptoms in this fatal disease.

Limitations of the study

This study is not without limitations. The main shortcoming deals with the small number of patients enrolled in the study, which was mainly due to the applied inclusion criteria. The second limitation is the short observation time, so future studies are warranted to explore the long-term effects of AAT in patients with ALS. Finally, the generalizability of dog-assisted treatments might be limited by some factors, both patients related (*e.g.* dog allergies or fear of dogs) and/or context related (*e.g.* availability of trained dogs and personnel, associated costs). However, as for the last potential shortcomings, we do believe that additional demonstrations of efficacy may stimulate collaboration between rehabilitation centers and AAT experts' teams in order to promote synergistic rehabilitation programs for patients with ALS.

Conclusions

This pilot study provides preliminary evidence that dog-assisted therapy can be used as a strongly effective rehabilitation strategy in patients with ALS. Additionally, the obtained findings suggest that, in terms of both motor and psychological outcomes, this type of therapy produces better results compared to traditional treatments.

The clinical relevance of the observed improvements, however, requires further investigations. In particular, while our study has shown a significant amelioration of balance and endurance clinical measures, and both patients and clinicians generally reported an improvement of related clinical symptoms, we are aware that more specific tools relating outcome measures to global assessments of overall clinical status will be essential in future studies to explore the clinical significance of treatment effects.

In conclusion, this study provides first evidence that AAT is a powerful rehabilitation strategy in patients with ALS, improving both motor and psychological symptoms, and therefore possibly ameliorating quality of life.

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Footnotes

Conflicts of interest: The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

Congresses: The Pilot study, along with the preliminary results, have been presented as posters at the 28th and 29th International Symposium on ALS/MND.

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