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Efficacy of an expanded integrative rehabilitation approach in patients with Guillain-Barre syndrome: a case series

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Abstract

Introduction. The work aims to present the design of the physical rehabilitation program used in cases of Guillain-Barre syndrome in conditions of the neurorehabilitation department.

Methods. The work includes a description of three cases with Guillain-Barre syndrome. To assess the effectiveness of the rehabilitation strategy, the sensory assessment was performed according to the INCAT testing system and the muscle assessment – based on a 0–5 scale of manual testing. The patients underwent an assessment for general motor skills and orthostatic hypotension. Pain syndrome was assessed on a 10-point scale. The rehabilitation strategy included different interventional approaches and a large volume of functional and task-oriented exercises designed according to the method for the 4th degree of the Hughes scale targeting different motor skills of the patients.

Results. Improvement was observed in all tested movements of patients. For a proportion of tested movements, the differences between the initial and final testing scores were significant. All pain and sensory assessment results showed significant improvement.

Conclusions. The very small sample of patients was not enough to show the impact of the designed intervention on all outcomes, but the designed expanded strategy could be used in a future case-control study with a large group of participants to evidence the efficacy of the expanded cluster of interventions.

Key words: Guillain-Barre syndrome, physical rehabilitation, muscle strength, functional rehabilitation, adaptation

Introduction

Guillain-Barre syndrome (GBS) is an autoimmune disorder causing polyneuropathy as a result of a peripheral nerve injury. It is a rare neurological disease with a prevalence of 1.67–1.79 patients per 100,000 population [1]. The syndrome is found equally in all countries and races. The ratio of men to women with this condition is 3:2. This autoimmune condition is more common in adults than in children [2, 3]. The main trigger of Guillain-Barré syndrome is an infection, the administration of a vaccine, or surgical intervention (WHO 2016) [4]. All of these causative factors initiate a hypersensitivity reaction and an autoimmune process [5, 6]. Despite the autoimmune nature of the disease and the hypersensitivity reaction affecting the myelin, there are three clinical subtypes of Guillain-Barré syndrome: acute inflammatory demyelinating polyneuropathy (accounting for 70–80% of all cases worldwide), acute motor axonal neuropathy (accounting for 10–15% of total cases), and acute motor-sensory axonal neuropathy (accounting for 5% of overall cases) [7, 8]. Other clinical subtypes of GBS are much less common. The main manifestations of GBS are progressive weakness, peripheral pain in the arms and legs, as well as somatic sensory disturbances. Every third case leads to severe loss of ambulation, and in every fourth case, mechanical ventilation is ultimately required [9, 10].

Four degrees of severity of the disease have been defined. The first degree is a mild process, which is characterised by weak paresis, but does not cause difficulty in walking or in self-care (activities of daily living, ADL). The intermediate degree is characterised by gait disturbances (the patient needs support or an aiding device is used in gait). In the third degree, the patient is in bed and needs permanent care and the fourth degree is an extremely severe process characterised by bulbar syndrome requiring the use of mechanical lung ventilation [11, 12]. About 3% of cases with Guillain-Barré syndrome are fatal, 20% have some neurological limitations after recovery, and in 60–80% of cases, the outcome is complete recovery without residual deficits [13]. The therapeutic influence of exercise therapy on the autoimmune mechanism of diseases has been shown in different animal models and clinical trials [14–16].

The work aims to present the design of a physical rehabilitation program used in cases of GBS in patients of the neurorehabilitation department.

Subjects and methods

The research was conducted at the "Gratsia" rehabilitation centre in Yerevan, Armenia. The work includes a description of 3 cases with GBS. The patients were 26, 32, and 31-year-old males, diagnosed with GBS (acute inflammatory demyelinating polyneuropathy), who received 3 months of inpatient rehabilitation treatment at the centre. Upon admission to the centre, patients received pain management and immunoglobulin therapy. To ensure the efficacy of therapy, the rehabilitation intervention for the patients was designed based on the physiotherapy strategies described in the literature [17, 18]. The patients did not have any other comorbidities.

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Table 1. Muscle Strength Rating Scale

0	No movement, no muscle contractions
1	There is no movement, but there are visible muscle contractions
2	Performs the movement, but is not able to overcome gravity
3	Performs the movement, overcoming the force of gravity, but can not overcome a counteracting force
4	Performs a movement overcoming the force of gravity, resisting a weak counter-force
5	Resists and overcomes the counteracting force

Table 3. Assessment of pain syndrome

Points	Description
0	pain is insignificant
1	slight pain
2	slight pain
3	weak: pain
4	weak: pain
5	averagely expressed pain
6	averagely expressed pain
7	strongly expressed pain
8	strongly expressed pain
9	severe pain
10	unbearable pain

Table 2. Modified INCAT sensory assessment scores

Sensation	Grade	Normal sense	Abnormal sense			
		0	1	2	3	4
Pinprick	arms	at index finger	at index finger	at ulnar styloid process	at medial humerus epicondyle	at acromioclavicular joint
	legs	at hallux	at hallux	at medial malleolus	at patella	at anterior superior iliac spine
Light touch	arms	at index finger	at index finger	at ulnar styloid process	at medial humerus epicondyle	at acromioclavicular joint
	legs	at hallux	at hallux	at medial malleolus	at patella	at anterior superior iliac spine
Vibration sense	arms	at index finger	at index finger	at ulnar styloid process	at medial humerus epicondyle	at acromioclavicular joint
	legs	at hallux	at hallux	at medial malleolus	at patella	at anterior superior iliac spine
Joint position	arms	at index finger	at index finger	at ulnar styloid process	at medial humerus epicondyle	at acromioclavicular joint
	legs	at hallux	at hallux	at medial malleolus	at patella	at anterior superior iliac spine
Two-point discrimination	index finger	mm	mm			

A preliminary assessment of the study participants included physical examination and assessments of motor and sensory parameters. After the completion of the physical therapy program, the patients were assessed again. Muscle assessment was performed by manual assessment using a 0–5 scale (Table 1).

To assess the effectiveness of the rehabilitation strategy in the patients, a sensory assessment was performed according to the Inflammatory Neuropathy Cause and Treatment (INCAT) disability score [19]. The INCAT Sensory sum score (0–20) includes the sum of five domains presented in Table 2. Each domain is scored from 0 to 4. Two-point discrimination is measured in millimetres (normal sense or 0, < 4 mm; abnormal sense 1, 5–9 mm; 2, 10–14 mm; 3, 15–19 mm; 4, > 20 mm).

A functional capacity assessment was performed. The patients underwent an assessment for general motor skills and orthostatic hypotension. The range of motion of the joints of the upper and lower extremities was measured using a mechanical goniometer. Pain syndrome was assessed on a 10-point scale. The Numerical Pain Rating Scale (NPRS) is shown in Table 3.

A cardiac function assessment was performed to monitor the functional endurance of patients. The maximum intensity was estimated based on the resting heart rate (RHR+ 20). The patient's arterial blood pressure was also monitored.

Treatment protocol

All three patients were administered IVIG and methylprednisolone treatments. Non-steroidal anti-inflammatory agents were administered on demand. Before the physiotherapy program, the pain syndrome was managed with gabapentin. The protocol included 90 min of physical therapy intervention five days per week. The intervention consisted of two identical 45-min sessions with an 8-hour rest interval. Following the physical therapy session, the patients took part in occupational therapy sessions (improvement of ADLs, including domestic and community tasks) with the same duration (two sessions – 45 min each). Sensory training, including stimulation techniques with objects of different shapes, was added to the individual program.

The physical therapy sessions focused mainly on functional mobility, predominantly focusing on transfer and gait

Table 4. Principles of functional recovery according to the 4th degree of Hughes scale

Action to be performed	Time	Equipment	Instructions
Transfers	2 × 20 min	transfer equipment (wheelchair, slideboard, bed)	Teach to perform transfers according to the accepted procedures.
Ensuring standing position	1 × 15 min, gradually increasing the time to 45 min	special equipment for the verticalisation of the patients (stand in frame)	Controlling the position of the back, pelvis, and lower limbs. The goal is to prevent orthostatic hypotension.
Control of balance in a sitting position	2 × 20 min	exercises without equipment and with special equipment	Special focus on the correct positioning of the back and legs.
Leaning on the lower extremities	2 × 10 min	performing the exercises with special aiding equipment	Controlling the position of the back, pelvis, and lower limbs in standing positions, preventing orthostatic hypotension.
Mobility in bed and in wheelchair	15 min	exercises without special devices	Training in bed positioning and wheelchair management (a step-by-step protocol).
Passive movements	2 × 15 min	performed by a physiotherapist	Special focus on limitations in joints.

Table 5. Results of muscle strength, gait and ADL recovery

Assessment of muscle strength in the upper extremity			Assessment of muscle strength in the lower extremities		
Scapula	pre-intervention	post-intervention	Trunk	pre-intervention	post-intervention
Elevation	3	4	Flexion	1	3
	3	4		1	3
	2	4		0	2
Depression	2	4	Extension	1	4
	2	4		1	3
	1	3		0	2
Protraction	2	4	Lateroflexion	1	3
	2	4		1	3
	1	3		0	2
Retraction	3	4			
	3	4			
	2	3			
Shoulder joint	pre-intervention	post-intervention	Hip joint	pre-intervention	post-intervention
Flexion	4	5	Flexion	2	3
	3	4		2	3
	3	4		1	2
Extension	3	4	Extension	1	2
	3	4		1	1
	2	3		0	1
Abduction	3	5	Abduction	1	2
	2	4		1	2
	3	4		1	2
Adduction	3	4	Adduction	2	3
	3	4		2	2
	2	3		1	2
Internal rotation	3	4	Internal rotation	1	2
	2	3		1	2
	1	3		0	1
External rotation	3	4	External rotation	1	2
	2	4		1	2
	2	3		0	0

Arm joint	pre-intervention	post-intervention	Knee joint	pre-intervention	post-intervention
Flexion	4	5	Flexion	1	2
	3	4		1	1
	2	4		1	1
Extension	2	3	Extension	2	3
	1	3		1	2
	1	2		1	2
			Ankle joint	pre-intervention	post-intervention
Supination	3	4	Plantar flexion	2	3
	2	3		1	2
	1	3		1	2
Pronation	0.67 ± 0.58	1.67 ± 0.58	Dorsiflexion	0.67 ± 0.58	2.67 ± 0.58
Wrist joint	pre-intervention	post-intervention	Eversion	2	2
Flexion	1	2		1	2
	2	3		1	2
	1	2	Inversion	2	3
Metacarpophalangeal joints	pre-intervention	post-intervention		1	2
Flexion	1	2		1	2
	1	2			
	1	1	Toes	pre-intervention	post-intervention
Extension	1	3	Flexion	1	2
	1	2		0	1
	1	2		0	0
Thumb	pre-intervention	post-intervention	Extension	1	1
Flexion	1	3		0	1
	1	3		0	0
	1	2	Big toe	pre-intervention	post-intervention
Extension	2	3	Flexion	1	1
	1	2		0	1
	1	2		0	1
Abduction	1	2	Extension	1	2
	1	2		1	2
	1	2		1	1
Adduction	1	2	Adduction	0	1
	2	2		0	1
	0	1		0	0
Gait and ADL recovery					
10-metre walking (s)	pre-intervention	post-intervention	speed of gait (m/s)	pre-intervention	post-intervention
	36	18		0.38	0.84
	43	21		0.45	0.72
	47	27		0.26	0.64
Cadence for 10-metre walking (number of steps)	33	22	Barthel index (recovery of ADLs: 0–100)	51	87
	34	22		49	82
	37	25		41	74

For each assessed parameter, 3 values are presented in 3 different rows, representing patient-1 (line 1), patient-2 (line 2), and patient-3 (line 3).

training of patients. The methodology of functional recovery was adopted from Hughes and Cornblath [2] (Table 4).

Another focus of the exercise therapy was the strengthening of core and extremity muscles. The protocol included aerobic exercises used for that purpose (15 min of stationary cycling). The cycling period was increased in the course of the rehabilitation program by up to 20 min. The aerobic training intensity was within 45% of the predicted maximal HR reserve. Respiratory exercises were used aiming to increase/preserve the ventilator muscle strength (resistive and threshold breathing). The multidisciplinary team participated in the educational component of the program.

Physical therapy program

According to the initial assessment, short-term and long-term goals were defined.

Short-term goals included:

– Management of circulatory disturbances (prevention of orthostatic hypotension in the vertical position of the body),

– Sitting balance adjustments, and

– Ability to self-propel the wheelchair.

Long-term goals included:

– Independent transfer. With or without the wheelchair.

– Transferring from sitting position to supine.

– Improvements in ADL.

The physiotherapy strategy was designed according to the method based on the 4th degree of the Hughes scale [20], targeting different motor skills of the patients (Table 4).

Results

The results of the muscle strength assessment are presented in Table 4 and 5, which compares the muscle strength scores of the patient before and after physiotherapy.

During the initial and final assessment, the patients mentioned a pain syndrome in the joints and peripheral muscles. The assessment of pain sensation according to the visual analogue scale is presented in Table 6.

Improvement was observed in all tested movements of patients. For a proportion of tested movements, the differences between the initial and final testing scores were significant. All pain assessment results showed significant improvement.

Discussion

A systematic review conducted by Khan and Amatya [7] has shown high efficacy for the multidisciplinary approach in the rehabilitation of adult GBS patients and “satisfactory” evidence to support physical therapy intervention as one of the main intervention types. The authors have provided limited evidence for uni-disciplinary interventions. Our rehabilitation program for patients with GBS integrated multifaceted interventions, including immuno- and pharmacotherapy and strengthening, functional, task-oriented, and aerobic exercises. ADLs of patients were targeted by the occupational therapy sessions, supported by sensory training. The program included aerobic and respiratory exercises to improve cardiopulmonary endurance. Compared to all strategies presented in the review by Khan and Amatya [7], our program was an expanded multifaceted interventional approach. All interventions included in the rehabilitation program were “expanded” compared to the strategies described. The treatment strategy with immunoglobulin therapy was expanded and contained combined pain management and individually adjusted doses of methylprednisolone.

Table 6. Length of stay for the study participants combined with the INCAT sensory sum score and Pain Assessment results before and after physiotherapy

Length of stay	patient 1	98 days
	patient 2	102 days
	patient 3	109 days
Location of pain	primary assessment scores	final assessment scores
Neck	2	0
	3	0
	4	1
Upper extremity	3	0
	4	1
	5	1
Trunk	3	0
	3	0
	3	1
Lower limb	4	1
	4	1
	5	2
INCAT Sensory Sum Score	5	3
	6	5
	8	5

For each assessed parameter, 3 values are presented in 3 different rows, representing patient 1 (line 1), patient 2 (line 2), and patient 3 (line 3).

The physical examination of patients was conducted only after the pharmacotherapy and management of the acute stage manifestations. Then, a rehabilitation program was designed, where all interventions were planned individually based on the physical assessment results. The rehabilitation of GBS requires a team approach and the participation of different specialists. Other than the physical therapist, the team included an ergotherapist, a mechanotherapist, a psychologist, a social worker, a speech pathologist, and a respiratory therapist (in advanced stages, the patients develop communication disorders, aspiration, and respiratory dysfunction). The physical rehabilitation of patients with GBS was initiated after the acute stage. In the acute stage, the patients were prescribed bedrest and passive exercises in the pain-free range of motion. All patients received immunotherapy combined with pharmacotherapy. Intravenous immune globulins (0.4 gm/kg) with 0.5 gm of methylprednisolone intravenously per day were used as a combined immune and pharmacotherapy approach before the start of a physical rehabilitation program. Many publications suggest the use of monotherapy with IgG as an effective method of GBS therapy. However, the combined strategy was shown to be effective in a shorter period of administration and with better and sustained efficacy [21].

The “expanded” management strategy included all modalities of physical rehabilitation prescribed above, yet the most significant expansion compared to other physical rehabilitation programs for GBS was applied to the physical therapy intervention. Physiotherapy was mostly focused on functional recovery and task-oriented exercises. This approach was based on the principles of functional recovery according to the 4th degree of Hughes scale.

The "expansion" in methods of physical rehabilitation and the "expansion" in physical therapy programs supplemented with functional and task-oriented exercise approaches was the main difference between our program and strategies reported by other research groups [15, 16].

Another focus of the rehabilitation program was sensory recovery. The sensory recovery in the rehabilitation process is mostly due to the regeneration efforts of the tissue. However, there are some published works disputing the possible role of exercise in neuroregeneration [22]. For that purpose, we have applied sensory training, including stimulation techniques with objects of different shapes.

The functional and task-oriented exercise program was paralleled with occupational therapy aiming to improve the ADLs of patients [23–25]. The patients needed support in all basic ADLs. After the completion of the interventional program, the study participants were able to perform independently part of the ADLs (using the bathroom and toilet, grooming, and eating). However, they used aiding or adapted equipment to perform these actions. The slow speed and lack of wheelchair skills were registered before the intervention. According to the final assessment, the wheelchair skills in patients were significantly improved and unencumbered. The physical rehabilitation strategy included the verticalisation method with a tilt table, which resulted in a significant reduction of arterial pressure fluctuations.

The use of all interventional measures was based on an individualised approach. Intensive involvement of medical and nursing staff in the rehabilitation process was also necessary. The team worked primarily under the supervision of the neurologist and rehabilitation medicine doctor. An important component of the rehabilitation period was the integration of the patient's family or caregiver into the complex rehabilitation process. The degree of recovery from GBS depends on a number of factors: the well-organised work of the rehabilitation team, the integration of the patients and caregivers in the rehabilitation program, the severity of the disease, and the individual manifestations of the condition in the patients.

The physiotherapy intervention does not lead to the functional recovery of the injured peripheral nervous system, yet has an enhancing influence on the adaptive recovery of the skeletal muscles involved in the performance of functional motor skills.

Conclusions

The rehabilitation program used for patients participating in this study included an expanded approach to therapeutic and physical intervention methods. The therapy with immunoglobulin G was expanded with the administration of intravenous methylprednisone. The physical rehabilitation interventions were expanded with multifaceted approaches, and a particular focus was on the enlarged volume of functional and task-oriented exercises. Another expansion of the rehabilitation program was towards the patient education program, which also included the caregivers of the patients. The "expanded" categories of rehabilitative interventions produced significant improvements in all patients. The very small sample of patients was not enough to show the impact of the designed intervention on all therapy outcomes, but the designed strategy could be used in a future case-control study with a larger group of participants to evidence the efficacy of the expanded cluster of interventions.

Ethical approval

The research related to human use has complied with all the relevant national regulations and institutional policies, has followed the tenets of the Declaration of Helsinki, and has been approved by the Yerevan Haybusak University (approval No.: 21T3B210).

Informed consent

Informed consent has been obtained from all individuals included in this study.

Disclosure statement

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Conflict of interest

The authors state no conflict of interest.

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