

Effect of Proximal Muscle Strengthening on Distal Muscle Facilitation in Guillain Barre Syndrome

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ABSTRACT

BACKGROUND

In Guillain Barre Syndrome (GBS), there is symmetrical muscle weakness which ranges from mild weakness to severe palsy of all limbs. The motor symptoms start distally and move proximally. Proximal muscle weakness is primary and common factor in GBS. To overcome the weakness, one has to strengthen the muscle. Muscle activity of proximal segment is necessary for activation of distal segment. In fact, stable activity of distal parts needs controlling of the proximal parts. As distal muscle weakness is a major problem in post GBS individuals, they need to be facilitated with the help of proximal muscle strengthening.

METHODS

After obtaining the ethical committee clearance an experimental study was conducted among a total of 30 GBS subjects selected through convenience sampling. OPD subjects were given proximal muscle strengthening for 6 weeks. Each subject was examined by modified sphygmomanometer test (MST) and functional independence measure scale (FIMS) before and after the study.

RESULTS

Result was calculated by using MST and FIMS. Exercises showed extremely significant difference on MST [p = 0.0001, t = 11.924] on handgrip strength, [p value = 0.0001] t = 12.334] on plantar flexion, [p value = 0.0001, t = 9.558] on dorsiflexion. FIMS [p value = 0.0001, t = 25.699] extremely significant difference was seen.

CONCLUSIONS

Proximal muscle strengthening is found to be effective for distal muscle facilitation in Guillain Barre Syndrome.

KEY WORDS

Guillain Barre Syndrome, Proximal Muscle Strengthening, Distal Muscle Weakness, Functional Mobility, Modified Sphygmomanometer Test, Functional Independence Measure Scale

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BACKGROUND

Guillain-Barré Syndrome (GBS) is defined as an acute inflammatory demyelinating polyradiculoneuropathy that affects nerve roots and peripheral nerves leading to motor neuropathy and flaccid paralysis.¹ GBS is usually monophasic immune mediated disorder.² Symmetrical motor paralysis occurs due to the demyelination of peripheral nerve axons, which gradually progress and ascends from the lower extremities and leads to tingling, burning sensations and areflexia.³ It usually follows viral infections including Epstein-Barr virus, Campylobacter jejuni, cytomegalovirus, mycoplasma pneumonia and influenza virus.⁴ Symptoms usually peak in 2 to 4 - week time period followed by a recovery period that can extend from week to months⁵ After the plateau phase of 2 - 4 weeks, recovery begins with gradual resolution if paralysis that last 1 - 2 years.⁶

Motor symptoms starts distally and move proximally, first there is involvement of lower limb than upper limb then progressively it involves trunk and cranial muscles. variable symptom is pain, tenderness occurs on deep pressure specially to motor points in muscle and nerve trunk and also parasthesia.⁷ Annual incidence is 1 - 2 per 100,000 worldwide.^{8,9} Men are more likely to be affected than Women with the ratio of 2:1.¹⁰ Younger population is the most common population that gets affected (30 - 50 years), although it can occur in any age.^{4,11}

Classification

There are other variants of Guillain Barre Syndrome. Commonly recognised variants of GBS include those with axonal forms, variants based on particular fibre type involvement (sensory or autonomic) and Miller Fisher syndrome.²

Axonal is divided into Acute Motor Axonal Neuropathy and Acute Motor Sensory Axonal Neuropathy

1. Acute motor axonal neuropathy (AMAN) - In AMAN there is only motor weakness without sensory symptoms or signs. Here sensory nerve conduction studies are normal and motor nerve studies are low or absent.
2. Acute motor sensory axonal neuropathy (AMSAN) - There is involvement of sensory nerves with severe residual disability. It affects adults rather than children.

Miller Fisher Syndrome is a triad of acute ophthalmoparesis, ataxia, and areflexia, now known as Fisher's syndrome. Clinical features include - facial weakness, oropharyngeal weakness, internal ophthalmoparesis and central nervous system involvement. MFS is generally, self-limiting condition with good prognosis.²

Pathophysiology

Immune system begins to attack the body itself, due to involvement autoimmune responses. Cross reaction is caused between immune responses and the neural tissue. GBS primarily involve the Schwann cell that affects the spinal roots and nerve, this results in segmental demyelination of the nerve process and later proliferation of the Schwann cell. The axon remains intact and conduct an impulse with reduced velocity, later axonal degeneration may occur in some patients which

cause complete conduction block. The peripheral nervous system is associated with perivascular lymphocytic inflammatory exudates. Recovery occurs by axonal regeneration and remyelination of peripheral axons. Internodal distance is less because of myelin sheath is thinner and there is increase in number of nodes of Ranvier. Nerve conduction velocity is within the normal limits in less severe cases. However, conduction velocity may be permanently abnormal, where axonal damage are occur.¹²

Normal physiotherapy treatment approach includes correct positioning in bed, hydrotherapy, isometrics, free exercises and aerobic exercises.¹³ These exercises concentrate more on distal extremities without focusing on proximal control. In GBS, Motor symptoms starts distally and move proximally, first, there is involvement of lower limb than upper limb then progressively it involves trunk, where proximal muscles are largely affected than distal muscle. Muscle activity of proximal parts is necessary for activation of distal parts. In fact the stable activity of distal parts needs controlling the proximal parts.¹⁴ Proximal muscle strengthening exercises that includes open kinetic chain (OKC) and closed kinetic chain (CKC) exercises which further develop muscle strength and proximal stability i.e. stability of joints closest to the body such as shoulder joint and hip joint. Proximal muscles of upper limb concentrate on triceps brachii, biceps brachii, deltoids, pectoral is major and minor and lower limb focuses on muscles of hip musculature mainly gluteus Maximus, gluteus medias, quadriceps and hamstrings.¹⁵ In Guillain Barre syndrome, physical impairments are more prone to disability. Muscle weakness, paralysis and numbness can all affect the ability to move, stand and walk which makes patient highly dependent. Normal growth and development is believed to progress from proximal control to distal control. As Distal muscle weakness is major problem in post GBS individuals they are needed to strengthen in order to improve functional mobility, quality of daily living activities.¹⁶ Proximal muscle strengthening can be beneficial in improving the strength of distal muscle.¹⁷

METHODS

It was an experimental study carried out among subjects with GBS with distal muscle weakness and those who satisfied the inclusion criteria. The inclusion criteria were - diagnosed cases with Guillain Barre Syndrome, subjects with Manual Muscle Testing (MMT) grade 2 and above for proximal muscles. Subjects were excluded if they were Ventilator dependent, Recent Upper limb and lower limb Fractures, Concomitant conditions (cardiovascular diseases, malignancy) and severely fatigue subjects.

Intervention

This study was conducted in Krishna Hospital, Karad with a sample size of 30 (20 males / 10 females) after getting ethical approval from the institutional ethical committee. According to Alexandrescu R, Siegert RJ et al. $SD = 23, X = 30, \Sigma = 0.03$ was taken in consideration and Sample size was calculated by the formula $n = 4SD^2 / [(X \times \Sigma)^2]$. Subjects who were willing to participate in the study were included in the study by using consecutive sampling method for OPD subjects and

convenience sampling method for IPD subjects. Before proceeding to intervention, a written consent had been taken from them. The intervention had been given for 6 weeks and treatment will be given 5 times a week. Proximal muscle strengthening exercises was given for upper limb and lower limb that included exercises with assistance followed by active exercises and then progressively with resistance. Pre and post tests were done using the outcome measures modified sphygmomanometer test^{18,19} for assessing distal muscle strength and functional independence measure scale^{20,21} for functional mobility in subjects with Guillain barre syndrome.

Statistical Analysis

Statistical analysis was performed using Instat software. Comparison was done within the group by using paired ‘t’ test. The result were presented as mean ± standard deviation (SD).

RESULTS

Total 30 patients were included in the study. Out of which 20 were male and 10 were female. Primary outcomes used for the result were modified sphygmomanometer test and functional independence measure scale which were taken before and after the study. Paired ‘t’ test was used to analyse the effect of proximal strengthening exercises on distal muscle facilitation.

Modified Sphygmomanometer test showed extremely significant improvement in right handgrip strength with p value of 0.0001. Pre interventional value of mean and standard deviation was 32.26 ± 6.512 and post interventional value of mean and standard deviation was 77.26 ± 25.507 and also showed extremely significant improvement in left handgrip strength that is p value of 0.0001. Pre interventional value of mean and standard deviation was 31.933 ± 6.00 and post interventional value of mean and standard deviation was 80.133 ± 26.673 (Table 1)

MST showed extremely significant improvement in right lower limb (plantar flexion) with p value of 0.0001. Pre interventional value of mean and standard deviation was 32.6 ± 7.262 and post interventional value of mean and standard deviation was 80.93 ± 26.795 and also showed extremely significant improvement in left lower limb (plantar flexion) with p value of 0.0001. Pre interventional value of mean and standard deviation was 34.53 ± 6.68 and post interventional value of mean and standard deviation was 82.333 ± 22.997 (Table 2)

MST showed extremely significant improvement in right limb (dorsiflexion) with p value of 0.0001. Pre interventional value of mean and standard deviation was 26.86 ± 5.399 and post interventional value of mean and standard deviation was 57.6 ± 21.626 and also showed extremely significant improvement in left lower limb (dorsiflexion) with p value of 0.0001. Pre interventional value of mean and standard deviation was 27 ± 5.298 and post interventional value of mean and standard deviation was 58.8 ± 21.474 (Table 3).

Functional independence measure scale showed extremely significant improvement with p value of 0.0001. Pre interventional value of mean and standard deviation was 76.96 ± 6.305 and post interventional value of mean and standard deviation was 115.266 ± 9.040 (Table 4).

	Pre-Training Mean ± SD	Post-Training Mean ± SD	P Value
MST (Right Handgrip)	32.26 ± 6.512	77.26 ± 25.507	< 0.0001
MST (Left Handgrip)	31.933 ± 6.00	80.133 ± 26.673	< 0.0001

Table 1. Comparison of Mean and SD Pre- and Post-Treatment of MST for Right and Left Upper Limb

Pre and post treatment values shows that there is extremely significant difference in MST for right and left handgrip (<0.0001)

	Pre-Training Mean ± SD	Post-Training Mean ± SD	P Value
MST (Right Plantarflexion)	32.6 ± 7.262	80.93 ± 26.795	< 0.0001
MST (Left Plantarflexion)	34.53 ± 6.68	82.333 ± 22.997	< 0.0001

Table 2. Comparison of Mean and SD Pre- and Post-Treatment of MST for Right and Left Plantar Flexion

Pre and post treatment values shows that there is extremely significant difference in MST for right and left plantarflexion (<0.0001)

	Pre-Training Mean ± SD	Post-Training Mean ± SD	P Value
MST (Right Dorsiflexion)	26.86 ± 5.399	57.6 ± 21.626	< 0.0001
MST (Left Dorsiflexion)	27 ± 5.298	58.8 ± 21.474	< 0.0001

Table 3. Comparison of Mean and SD Pre- and Post-Treatment of MST for Right and Left Dorsiflexion

Pre and post treatment values shows that there is extremely significant difference in MST for right and left dorsiflexion (<0.0001)

	Pre-Training Mean ± SD	Post-Training Mean ± SD	P Value
FIMS	76.96 ± 6.305	115.266 ± 9.040	< 0.0001

Table 4. Comparison of Mean and SD Pre- and Post-Treatment of Functional Independence Measure Scale

Pre and post treatment values shows that there is extremely significant difference in functional independence measure scale (<0.0001)

DISCUSSION

Guillain Barre Syndrome (GBS) is an acute, monophasic, symmetrically progressive, ascending demyelinating polyneuropathy characterized by rapidly evolving symmetrical limb weakness, areflexia, absent or mild sensory signs, and variable autonomic disturbances.²² Symptoms usually peak in 2 to 4 - week time period followed by a recovery period that can extend from week to months.⁶ The motor symptoms start distally to proximally involving lower limbs, preceding that of upper limb and can progress to trunk where proximal muscles goes into major weakness followed by distal muscles.⁷ Muscle activity of proximal parts is necessary for activation of distal parts and the stable activity of distal parts needs controlling the proximal parts.¹⁴

In GBS, there is delayed recovery in distal parts of limbs. Normal Motor development is believed to progress from proximal control to distal control and gross movements to fine movements.²³ As distal muscle weakness is a major problem in GBS can be facilitated with the help of proximal muscle strengthening. Physical impairments in GBS are most disabling. Muscle weakness, paralysis and numbness makes patient highly dependent. Proximal muscle strengthening is helpful for making patient functionally independent and improving functional mobility.

In the present study, proximal muscle strengthening exercises were given which include exercises with assistance followed by active exercises and then with progressively resistance. There was significant improvement in distal muscle strength and functional mobility after the entire treatment programmed. The measurement taken by modified

sphygmomanometer and functional independence measure scale

Some previous study evaluated physical therapy and functional motor recovery in patient with Guillain Barre Syndrome – case report by Antoaneta Dimitriva concluded that physiotherapy helps in functional improvement of the paretic extremities which is associated with gradual muscle strengthening and improved balance, gait and increasing movement speed.¹³ The study rehabilitation of the marathon runner with Guillain-Barre syndrome by Fisher TB, Stevens JE showed that after 3 weeks patient showed marked improvement in functional mobility as measured by functional independence measure scale.¹ The study activation of shoulder girdle muscle during gripping task by Nazanin Nakhaie stated that muscle activation of proximal parts is necessary for distal activities proximal muscle provide stabilized and controlled base for distal parts activities.¹⁴

These results from statistical analysis of present study supported the alternative hypothesis which stated that subjects treated by proximal exercises improved distal muscle facilitation in post GBS individuals. As Proximal muscle strengthening including both OKC and CKC led to muscle strength improvement because they stimulated mechanoreceptors in and around the joint and increased muscle fiber, increased firing of muscle spindles and the number of motor units increased during these resistance exercises.^{24,25} In kinetic chain, muscle activation occurs in the muscle that crosses the moving joint, the overlapping segment is connected via joint and this create a system whereby movement at one joint produced or affected movement at another joint in kinetic link.²⁶ So, we had seen improve the strength in distal muscles of upper limb and lower limb with proximal strengthening exercises GBS follows the pattern of demyelination / remyelination where clinical recovery follows remyelination at the spinal root level such that the first nerve segments to be demyelinated are the last to be remyelinated.²⁷

Therefore, it is proven that interventions like proximal strengthening exercises shows better result with good prognosis in recovery of distal muscle facilitation.

CONCLUSIONS

The effect of proximal muscle strengthening is clinically significant on distal muscle facilitation and improves functional mobility in subjects with Guillain Barre Syndrome.

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