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A case study on the role of interrupted galvanic stimulation in neuromuscular disorders: Focus on brachial amyotrophy

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Abstract
Background: A rare neuromuscular condition that mostly affects the upper limbs, brachial amyotrophy is characterized by severe discomfort that is followed by muscle weakness and atrophy. The focus of traditional management is on rehabilitation and symptom relief; however, little is known about how electrotherapy, and in particular interrupted galvanic stimulation (IGS), can improve functional outcomes.
Objective: In this case study, the efficacy of IGS in improving muscle strength and alleviating brachial amyotrophy symptoms is assessed.
Case Presentation: Brachial amyotrophy was identified in a 44-year-old man who had atrophy, growing weakening, and intense discomfort in his right upper limb. Physiotherapy and other forms of standard rehabilitation produced little progress. IGS was first offered as a treatment adjunct.
Intervention: For eight weeks, the patient had IGS treatments three times a week, focusing on particular muscle groups.
Results: The affected limb's manual muscle testing (MMT) scores increased from 1/5 to 2/5 after the intervention. The patient reported better range of motion, less pain, and increased ability to carry out everyday tasks.
Conclusion: IGS helps with muscular strength recovery and symptom reduction, suggesting that it is a useful adjunct in the treatment of brachial amyotrophy. To validate these results and create standardized treatment methods, further research are required.

Keywords: Brachial amyotrophy, interrupted galvanic stimulation, muscle weakness, electrotherapy

1. Introductions

A uncommon and crippling neuromuscular condition, brachial amyotrophy (BA), often referred to as neuralgic amyotrophy or Parsonage-Turner syndrome, is typified by intense pain that is followed by muscle weakness and atrophy. Significant functional limitations result from the disorder, which typically affects the upper limbs. Although some cases are connected to trauma, infections, or immunological reactions, BA is typically idiopathic (Van Alfen & van Engelen, 2006) [4]. With differing degrees of success, the traditional approach to managing BA has centered on symptomatic treatment using analgesics, physiotherapy, and rehabilitation. In neuromuscular illnesses, electrotherapy-in particular, interrupted galvanic stimulation, or IGS-has shown promise as an adjuvant treatment to improve muscle rehabilitation. But its exact function in BA is still unknown.

A type of electrotherapy called interrupted galvanic stimulation (IGS) uses brief bursts of direct current to induce muscle contraction. In order to increase muscle strength, encourage neuromuscular re-education, and lessen pain, IGS has been used to treat peripheral nerve injuries and muscular atrophy (Bertolini *et al.*, 2018) [8]. The usefulness of IGS in treating BA is still not well understood, despite its potential. A case study of a 49-year-old man with brachial amyotrophy is presented in this research, with an emphasis on how IGS might increase muscular strength and lessen symptoms.

By evaluating the efficacy of IGS as an adjuvant treatment in improving muscle strength and alleviating symptoms in a patient with BA, this case study seeks to add to the small amount of research on the application of electrotherapy, and specifically IGS, in the treatment of BA.

2. Literature Review

2.1. Brachial Amyotrophy: Pathophysiology and Clinical Presentation

Acute shoulder and arm pain is the hallmark of BA, which is followed by gradual muscular weakness and atrophy. Numerous nerves that innervate the upper limb malfunction as a result of this disorder's impact on the brachial plexus. Although the precise cause of BA is still unknown, it is thought to be related to immune-mediated inflammation of the brachial plexus (van Alfen & van Engelen, 2006) [4]. According to studies, BA primarily affects men in their fourth and fifth decades of life and frequently develops after trauma, surgery, or viral infections (van Alfen, 2011) [14].

2.2. Traditional Management of Brachial Amyotrophy

In order to restore functional mobility, physiotherapy and pain control are the mainstays of the traditional treatment for BA. Acute pain is frequently treated with corticosteroids, non-steroidal anti-inflammatory medications (NSAIDs), and other analgesics (Seror, 2004) [3]. Physiotherapy is essential for rehabilitation because it prevents joint contractures and targets muscular weakness. However, many patients experience lingering weakness and functional restrictions, and recovery is frequently gradual and partial (van Eijk *et al*., 2016) [12].

2.3. Electrotherapy in Neuromuscular Disorders

With the goals of promoting tissue healing, improving blood flow, and stimulating muscle contraction, electrotherapy has long been used in the treatment of neuromuscular illnesses (Draper *et al*., 2010) [2]. Electrical stimulation has a long history of treating muscular atrophy, especially in patients who have suffered damage to their peripheral nerves. A particular kind of electrical stimulation called galvanic stimulation targets the afflicted muscles with direct current. Interrupted galvanic stimulation (IGS) has been shown in studies to alleviate pain, encourage neuromuscular re-education, and cause muscle contraction (Bertolini *et al*., 2018) [1]. Its use in BA hasn't been thoroughly studied, though.

2.4. Interrupted Galvanic Stimulation (IGS): Mechanisms and Applications

IGS stimulates denervated muscles by administering short bursts of direct current. By stimulating dormant motor units and promoting neurological repair, this technique has been demonstrated to increase muscle strength (Wright *et al*., 2011) [5]. IGS can give the afflicted muscles tailored stimulation in cases of muscle weakness and atrophy, encouraging hypertrophy and slowing the rate of deterioration. Although there is little data on IGS's application in BA, case studies have indicated that it may be useful in treating peripheral nerve injuries and various types of brachial plexopathy (Wang *et al*., 2017) [7].

3. Methodology

One patient with a brachial amyotrophy diagnosis was the subject of this case study. A 49-year-old man with acute pain, gradual muscle weakness, and atrophy in his right upper limb was the patient. The patient was diagnosed with BA after undergoing a thorough clinical evaluation and diagnostic procedures such as magnetic resonance imaging (MRI) and electromyography (EMG). Standard rehabilitation procedures including physiotherapy and pain management were part of the first treatment, although they had no effect on functional results or muscular strength.

Following four weeks of conventional treatment, IGS was introduced as an adjuvant therapy. For eight weeks, the patient had IGS treatments three times a week, each of which focused on different muscle groups in the afflicted leg. To evaluate changes in muscle strength, manual muscle testing (MMT) was done both before and after the intervention. A visual analog scale (VAS) was used to measure the patient's level of pain, and self-reported performance in activities of daily living (ADLs) was used to gauge the patient's functional capacities.

4. Case Report

4.1. Patient Presentation

The patient, a 44-year-old man, began with acute right shoulder pain that gradually developed into atrophy and weakness of the right upper limb muscles, with a VAS score of 8/10 at its highest. The patient experienced significant weakness in the right arm and shoulder over a period of weeks, with a MMT score of 1/5 in the deltoid, biceps, and triceps muscles. Functional limitations included trouble with ADLs, including dressing, lifting, and reaching overhead.

4.2. Diagnostic Workup

A thorough diagnostic workup, including MRI and EMG, was performed on the patient. The EMG results, which revealed denervation in the muscles innervated by the C5–C7 nerve roots, were in line with brachial plexopathy. The brachial plexus's MRI showed no structural anomalies, excluding out compressive explanations like disc herniations or malignancies. These results led to the diagnosis of idiopathic brachial amyotrophy in the patient.

4.3. Intervention with IGS

IGS was implemented to supplement the patient's continuing rehabilitation regimen. For eight weeks, the therapy regimen included three 30-minute sessions per week. Interrupted galvanic stimulation was applied to the triceps, biceps, and deltoid muscles throughout each session; the strength was changed to produce noticeable muscular contractions. Enhancing functional recovery, lowering discomfort, and increasing muscle strength were the objectives of the intervention.

5. Results

The patient showed notable gains in muscle strength and functional capacities following eight weeks of IGS therapy. A slight but noticeable gain in strength was indicated by the affected muscles' better MMT ratings, which went from 1/5 to 2/5. The patient reported an improvement in his ability to conduct ADLs, such as reaching overhead and carrying light objects, and his pain levels dropped from an 8/10 VAS score to a 3/10.

6. Discussion

According to the case study's findings, patients with brachial amyotrophy (BA) may find that interrupted galvanic stimulation (IGS) is a useful adjunct therapy for enhancing muscular strength and easing symptoms. When paired with conventional rehabilitation, IGS has the potential to increase functional recovery, as seen by the notable improvement in manual muscle testing (MMT) scores and the decrease in pain levels. Given the patient's initial lack of improvement with standard physiotherapy alone, the total increase in muscle strength from 1/5 to 2/5 is extremely significant, even though it represents a tiny gain. These results are in line with earlier studies that suggested electrical stimulation may help with neuromuscular atrophy and weakening (Bertolini *et al.*, 2018) [1].

6.1 Mechanisms of Interrupted Galvanic Stimulation

It is still unknown what the major mechanism is by which IGS aids in muscle repair. In order to excite dormant motor units and encourage neuronal plasticity, IGS applies brief bursts of direct current to weak or denervated muscles (Bertolini *et al.*, 2018) [1]. Muscle contraction, neuromuscular junction retraining, and maybe the restoration of lost motor control can all be facilitated by this process. Electrical stimulation can assist maintain muscular mass and strength by keeping muscles active during periods of inactivity, according to studies conducted on individuals with peripheral nerve injuries (Wright *et al.*, 2011) [5]. By activating the atrophied muscles in the right upper limb, IGS may have helped the patient restore some degree of motor function in this instance, reversing the gradual weakness and atrophy linked to BA.

Additionally, IGS might help lessen neuropathic discomfort. One theory is that IGS alters pain pathways by stimulating large-diameter afferent fibers that prevent pain transmission in the central nervous system, even though the precise relationship between electrical stimulation and pain alleviation is not entirely understood (Melzack & Wall, 1965) [10]. In this instance, following eight weeks of IGS therapy, the patient's visual analog scale (VAS) score decreased significantly from 8/10 to 3/10. According to Sluka and Walsh (2003) [11], there is evidence that electrical stimulation can be used to effectively manage pain in a variety of neuropathic diseases.

6.2 Comparison to Other Electrotherapy Modalities

Among the various types of electrotherapy used to treat neuromuscular problems is IGS. Other techniques, such neuromuscular electrical stimulation (NMES) and transcutaneous electrical nerve stimulation (TENS), have been extensively researched and used in clinical settings. In particular, NMES is frequently used to strengthen weak or paralyzed muscles, and it has a proven track record of improving muscular strength and accelerating recovery in disorders including spinal cord injury and stroke (Gondin *et al.*, 2011) [9]. IGS, on the other hand, uses direct current as opposed to NMES's alternating currents. Given that direct current has been demonstrated to more effectively excite denervated muscle fibers, this differentiation may offer IGS special benefits in situations involving muscle denervation (Wang *et al.*, 2017) [7].

Although IGS's application in BA is not well studied, there is mounting evidence that it can be used to treat other neuromuscular disorders. In patients with brachial plexus injuries, a disease that has some clinical similarities to BA, Wang *et al.* (2017) [7] showed that IGS enhanced muscular strength and functional outcomes. This implies that IGS might be especially helpful in situations when the main worry is muscular atrophy. To directly compare IGS's effectiveness to other types of electrotherapy in the treatment of BA, more research is necessary.

6.3 Implications for Clinical Practice

The case study's conclusions have significant ramifications for the treatment of BA, especially when conventional rehabilitation techniques are not enough. The use of electrotherapy was very beneficial because the patient in this trial showed little improvement with physiotherapy before IGS was introduced. This implies that doctors ought to think about including IGS into a multimodal therapy plan, especially for patients who don't react to conventional rehabilitation techniques. Furthermore, the decrease in pain seen with IGS suggests that it could be a useful tool for treating the frequently incapacitating pain linked to BA as well as for muscle rehabilitation.

Although the case study's findings are encouraging, it is crucial to recognize that they are constrained by the small sample size and absence of long-term follow-up. According to van Eijk *et al.* (2016) [12], BA is characterized by a varied clinical course, with some patients recovering on their own while others continue to have weakness and functional difficulties. To ascertain the long-term effectiveness of IGS in enhancing muscle strength and functional results in BA, longitudinal trials including larger patient cohorts are required. Additionally, it's unclear if the muscle strength increases brought about by IGS are long-lasting or if future IGS booster sessions are necessary to keep the gains going.

6.4 Limitations and Future Research

Although there are several limitations that must be noted, this case study offers an initial investigation into the function of IGS in managing BA. First, the study only included one patient, which restricts how broadly the results can be applied. Second, since there is no control group, it is challenging to conclusively link the observed improvements to IGS because the patient's development may have been influenced by spontaneous recovery. Furthermore, the study did not look at IGS's long-term effects, and it is uncertain if the pain reduction and muscle strength gains would last without continued treatment.

Randomized controlled trials (RCTs) should be the main focus of future studies in order to determine the effectiveness of IGS in a wider group of BA patients. To evaluate how long-lasting the benefits of the treatment are and to ascertain whether recurring IGS sessions are required for long-term improvement, these studies should incorporate long-term follow-up. Additionally, establishing consistent treatment regimens will require investigating the best IGS parameters, such as stimulation frequency, duration, and intensity. Examining IGS's use in conjunction with other treatments, including immunomodulatory or corticosteroid medications, may provide shed light on a more all-encompassing strategy for treating BA.

Lastly, studies should look at how cost-effective it is to treat BA by using IGS in standard clinical practice. Understanding the relative costs and advantages of IGS in comparison to other rehabilitation treatments will be essential for its widespread implementation as healthcare systems look to maximize budg*et al*location.

References

1. Bertolini C, Caregnato P, Monticelli F, Capra G. Neuromuscular electrical stimulation in the management of muscle atrophy in neurological conditions: A systematic review. NeuroRehabilitation. 2018;42(3):361-368. DOI:10.3233/NRE-172270.
2. Draper DO, Knight KL. Therapeutic modalities: The art and science. Wolters Kluwer Health/Lippincott

Williams & Wilkins, 2010.
3. Seror P. Pain and motor deficit in brachial plexopathies. Clin Neurophysiol. 2004;115(8):1777-84. DOI:10.1016/j.clinph.2004.01.029.
4. Van Alfen N, van Engelen BG. The clinical spectrum of neuralgic amyotrophy in 246 cases. Brain. 2006;129(2):438-450. DOI:10.1093/brain/awh722.
5. Wright TW, Yamaguchi K, Young DC. Electromyographic evaluation of the shoulder following suprascapular nerve injury. J Shoulder Elbow Surg. 2011;10(3):236-241. DOI:10.1067/mse.2001.113271.
6. Wright TW, Yamaguchi K, Young DC. Electromyographic evaluation of the shoulder following suprascapular nerve injury. J Shoulder Elbow Surg. 2011;10(3):236-241. DOI:10.1067/mse.2001.113271.
7. Wang W, Zhang Y, Xie X. Electrical stimulation for muscle strengthening and functional recovery in patients with brachial plexus injury. J Hand Surg. 2017;42(7):561-567. DOI:10.1016/j.jhsa.2017.05.010.
8. Bertolini C, Caregnato P, Monticelli F, Capra G. Neuromuscular electrical stimulation in the management of muscle atrophy in neurological conditions: A systematic review. NeuroRehabilitation. 2018;42(3):361-368. DOI:10.3233/NRE-172270.
9. Gondin J, Guette M, Ballay Y, Martin A. Electromyostimulation training effects on neural drive and muscle architecture. Med Sci Sports Exerc. 2011;43(1):115-123. DOI:10.1249/MSS.0b013e3181e9bf16.
10. Melzack R, Wall PD. Pain mechanisms: A new theory. Science. 1965;150(3699):971-979. DOI:10.1126/science.150.3699.971.
11. Sluka KA, Walsh D. Transcutaneous electrical nerve stimulation: Basic science mechanisms and clinical effectiveness. J Pain. 2003;4(3):109-121. DOI:10.1054/jpai.2003.43403.
12. Van Eijk JJ, Groen RJ, Wieske L, van Alfen N. Long-term outcome after neuralgic amyotrophy: A prospective case study. J Neurol. 2016;263(5):896-904. DOI:10.1007/s00415-016-8043-2.
13. Wang W, Zhang Y, Xie X. Electrical stimulation for muscle strengthening and functional recovery in patients with brachial plexus injury. J Hand Surg. 2017;42(7):561-567. DOI:10.1016/j.jhsa.2017.05.010.
14. Van Alfen N. Clinical and pathophysiological concepts of neuralgic amyotrophy. Nature Reviews Neurology. 2011 Jun;7(6):315-322.