



CASE REPORT

Rhabdomyolysis After Implementing Whole-Body Electromyostimulation: A Case Study

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Abstract

Whole-body electromyostimulation is a new approach used to achieve weight loss and build muscles by activating different muscles groups through voluntary contractions generated by electrical impulses.

This alternative approach is operated by a certified personal trainer, regulating the intensity of the electrical impulses to aid the muscular system to contract. Unaccustomed use of this technique leads to muscle destruction and a rise in creatine kinase level.

A 25-year-old female began this therapy and experienced right flank tenderness associated with elevated serum creatine kinase (CK) levels. An impression of Rhabdomyolysis in the Emergency Department was given, followed by intravenous (IV) fluid administration. The patient consequently improved and was discharged with instructions.

The study was projected to spread awareness regarding Whole-body electromyostimulation, which is tremendously promoted in Bahrain. This therapy may aid in client monitoring and improve the prognosis.

Keywords: Adult; Electric stimulation therapy; Muscle; Musculoskeletal physiological phenomena; Rhabdomyolysis; Weight loss

Introduction

Over the years, various approaches to achieve weight loss have been followed. A new technology known as whole-body electromyostimulation (WB-EMS) has been launched.

EMS is a training technique which was propelled in Germany in 2009, and the primary target is to activate the entire body's muscles through voluntary contractions, generated by electrical impulses

emitted from the EMS training suit, under the supervision of a trainer, to improve muscle building and reduce body mass loss.¹⁻⁴

Despite the fact that it is suggested as a beneficial technique to people experiencing difficulties in training, a limited number of cases (sports players and dancers) have revealed that EMS can lead to muscle destruction and raised serum creatine kinase (CK) levels, eventually leading to rhabdomyolysis.^{5,6}

No established data regarding healthy individuals using only WB-EMS as a risk factor leading to rhabdomyolysis is documented. This case report attempts to spread awareness regarding EMS.

Case presentation

A 25-year-old female [Body Mass Index of 27.6 kg/m²], a known case of patellofemoral syndrome, reported to the accident and emergency department, with recent right flank pain in a known tertiary hospital in Bahrain.

Patient presentation

The patient is a known case of patellofemoral syndrome with a related ongoing chronic knee pain. The purpose of performing whole-body electromyostimulation was made for rehabilitation and quadriceps muscle strengthening. The sessions conducted for the patient consisted of whole-body maneuvers with electric stimulation therapy under the supervision of a certified trainer.

During each training session, the patient was wearing a German-made suit modulated by a tablet, and it was adapted with a strength of 80 Hz: 350 μ s over 4:1 electrical impulse's ratio and monitored by a trainer over 20 minutes period per session. The electrical impulses for each single muscle group were customized based on each patient's ability and modified by the trainer based on the pattern of the exercise given, Figure 1.

Four sessions of WB-EMS were performed for two weeks. However, 48 hours post 4th EMS training session, the patient developed symptoms of right flank pain.

Clinical case

The patient presented to the Emergency Department with a history of right-sided severe flank pain for the past two days. No history of weakness or numbness, gastrointestinal and urinary symptoms were observed. The patient is a known case of patellofemoral syndrome. The patient had no such previous episodes. Past medical, medications, trauma, and family history were reported. Written informed consent was obtained from the patient.

Physical examination was completed, and the outcome was diffused right flank tenderness only.

Initial laboratory investigations were acquired, including urea & electrolytes and renal function test, which were within acceptable limits. Creatinine kinase level was 1316.2 unit/L (normal range: 21-180 unit/L).

An acute rise of serum creatine kinase levels by seven folds post-WB-EMS with myalgia and tenderness on the right external oblique muscles on examination is indicative of rhabdomyolysis. Serum creatine kinase level was 1316.2 unit/L initially, and then it declined to 1083.8 unit/L after administering three units of 9% Sodium Chloride (NaCl) in 4 hours. Urinalysis was not carried out owing to the patient's refusal. This is crucial to exclude acute kidney injury as a complication (measurement of myoglobin levels). Nonetheless, a renal function test was obtained, and the result was reassuring with no deranged levels.

The patient was cleared for discharge, instructed to increase fluid intake, and advised to return to the Emergency Department if symptoms worsen or any complication arose.

Follow-up

After discharge, the patient stated that the pain continued for three days. Follow-up, laboratory readings were repeated three times, and the grades of CK level were as follows: 509, 508, and 78 units/L with an intermission of three days, respectively. In addition, a borderline elevation in lactate dehydrogenase enzyme level 219 IU/L (normal range 135 - 214 IU/L) was observed seven days after discharge.

The most recent value of serum CK level was 78 unit/L confirmed that rhabdomyolysis and CK enzyme elevation was not attributable to secondary causes such as metabolic, endocrine, neuromuscular diseases, or medication uses in patients without medical conditions. Additionally, the patient underwent weekly coronavirus disease-2019 (COVID-19) swab. Thus, the elevation of CK levels due to coronavirus was ruled out. Besides, this suggests an impression of exertional rhabdomyolysis due to micro muscle injury damage triggered by the practice of WB- EMS.

Discussion

Electrical muscle stimulation is a non-invasive method that causes voluntary muscle contraction using pads enclosed toward the muscle. It is initiated by a battery-operated device to send electrical impulses to aid the contraction.⁷

A new training technique with an equivalent concept was launched based on the EMS method, known as Whole-body Electromyostimulation. It is a specific suit that has electrodes attached to the body, which works on larger and multiple muscle groups, including arms, chest, abdomen, back, glutes, and thighs.⁸

This method is operated by a certified personal trainer, who controls the strength of the impulses for each muscle group based on the trainee's tolerance.

A fixed strength of 85 Hz: 350 μ s is administered over 4-6 seconds with a 1- second rest ratio for 20-30 minutes continuously per session once or twice a week.⁸

Various reports revealed that WB-EMS is effective for rehabilitation; it is applied as a mode of exercising for people who have difficulties in training due to multiple factors.

Recently, it has been proven as a time-effective technique for a population who prefer promising results, including fat burning, building muscles, fitness, and rehabilitation.^{2,4,5}

In exertional rhabdomyolysis, the serum CK levels varied based on the intensity, modality, and duration of the exercise performed.⁹

In-depth, WB-EMS workouts are considered high-intensity exercises. It is performed in a short period of time and is associated with dynamic muscle activation.

The combination of customized exercises and high-intensity electrical impulses give rise to serum CK levels. This reveals that EMS led to muscle destruction and subsequent disturbance to muscle development as a physiological process in a short duration.^{6,10}

WB-EMS stimulates the musculoskeletal, physiological phenomena of voluntary muscle contraction by activating the isometric load on

the muscle involved. It is an isometric exercise with a high eccentric ratio load, and the eccentric contractions mainly trigger muscles by increasing the frequency rate of the motor unit stimulation in type 2 muscle fibers. It is utilized as a temporary energy reservation to delay lethargy and enhance muscle expansion and strengthening, which precipitates to the breakdown of muscles and leakage of the intracellular myofibril elements along with CK enzyme into the blood circulation in a short period of time, which lead to a peak in CK levels leading to rhabdomyolysis.^{8,11,12}

As far as it is known, multiple cases until the end of 2019 were identified with rhabdomyolysis and elevation in serum CK level post-EMS exercising, including soccer players, elite dancers, and healthy individuals applying push-ups. In this context, this is the earliest case reported in Bahrain.¹³⁻¹⁵

Muscle tenderness and elevated CK levels were similar to previous studies. Mild elevation of CK levels in this patient compared to the soccer players indicate the character of athlete variability. CK levels in soccer players are isolated as a result of eccentric muscle contraction due to the environment of their other exercises. And the use of WB-EMS led to hospital admissions as compared to this patient who has been discharged.¹³

Added to that, an elite dancer focused on lower body implementations, including 25 repetitions with the usage of WB-EMS, which led to the optimal CK levels. The patient described in this report underwent a small interval training once or twice a week.¹⁴

The patient is under evaluation as WB-EMS training is resumed with appropriate fitness and precautions. Further assessment will be provided if the patient presents with any new symptoms.

Conclusion

In conclusion, WB-EMS is an applicable and beneficial exercise to maintain muscle strengthening when conducted in a safe manner, with the supervision of a certified personal trainer.

This study was prepared to spread awareness about the profile of WB-EMS among trainers and clients who are considering this therapy. It declares that

WB-EMS should not be accomplished before using a medical evaluation. An initial baseline investigation and serum CK levels are recommended for clients willing to experience this technique. In addition, follow-up with clients experiencing myalgia after using EMS is mandatory.

Clients should be counseled to increase their fluid and nutritional intake. Instructions are given as essentials to minimize additional new cases.



Figure 1: I-motion software is a wireless technology using an iPad application that is used to adjust the intensity of the electrical impulses (arrows are used to increase or decrease the level of the impulses) derived to the suit electrodes by Bluetooth to aid contraction of the muscle. * Srdjan Pravuljac, An EMS trainer.

Ethical approval

Approval from the Bahrain Defense Force Royal Medical Services Research & Research Ethics Committee with a reference number 2020-419 has been obtained.

Author's contribution

Dr. Najla Waleed Alaraifi was involved in the writing, data collection, and analysis of the article.

Dr. Basem Mohammed Mustafa played a crucial role in the supervision of the Case study and review.

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Conflict of interest

None declared.

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