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Adjunctive Physiotherapy – A Case Report on the Management and Effective Treatment of Diabetic Neuropathic Foot Ulcer Using Adjunctive Physiotherapy

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Abstract

Physiotherapy must be considered and reprioritized as an adjunctive medical service for long term health and rehabilitation. Comprehensive physiotherapy has the potential to be administered in out-patient rehabilitation facilities, hospitals, and Thermal Health Centers. A review of select adjunctive physiotherapy methods will be presented along with a case report of the successful treatment, with rationally selected physiotherapeutic agents, of a Diabetic Neuropathic Foot Ulcer scheduled for surgical amputation.

By highlighting this case, the author is attempting to bring attention to familiar and time-tested therapies that have fallen out of use in a primary intervention context. This case report aims to exemplify that the role for rational physiotherapeutic methods stretches beyond current mainstream applications.

Historical Context. Will supply the historical and foundational work in the field of physiotherapy that contextualizes the rational basis for the applications described in the case.

Therapies. Lists the physiotherapy methods highlighted in this case, reviews the mechanism of action, discusses the therapeutic application, and provides modern citation for the rationalization of the therapy.

Case Report. Reviews a detailed narrative of the case in review. Covers intake, case history, progression of case, as well as clinical applications for physiotherapy as they arise in the course of case management.

Conclusion. Reviews the emphasis for reconsidering the role of Physiotherapy in the primary management of acute and chronic illness.

Keywords: physiotherapy iontophoresis, pulsed-shortwave diathermy, galvanic current, low-volt alternating current, hydrotherapy, physical agents, diabetic ulcer, chronic wound care

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Introduction

Physiotherapy, the rational application of physical agents and therapies, represents an under-utilized compendium of treatment options in 21st century American medical practice. With the increasing comorbidity effects of lifestyle illness – heart disease, metabolic syndrome, NIDDM, etc – therapeutics beyond pharmaceutical management alone must be considered for greater efficacy of patient outcomes. Physiotherapy has been applied in many forms for over a century [1-3]. By including a rational program of Physiotherapy, ideally in combination with comprehensive lifestyle intervention, a model for improved clinical outcomes will be presented using a case example of a patient treated by the author in late 2019-2020.

Historical Context

In the United States of America, the application of physical agents in healthcare has a history of empiric use that goes back hundreds of years. The rational and scientific codification of how to clinically apply, understand, and utilize these therapies began to occur toward the end of the 19th century and into the early 20th; with contributions from authors such as Baruch, Abrams, and Kellogg [1-4]. Toward the middle of the 20th century authors such as Kovacs and Johnson had framed the practice of physical therapy, through their publications, as a robust set of therapeutic agents that had application in a wide range of disease treatments [5, 6]. The later 20th century saw the rise in popularity of pharmaceutical disease treatment and management.

With this, physical therapy no longer retained popular practice for its spectrum of applications and became relegated mainly to the realm of treatment for musculoskeletal issues, chronic pain, and physical injury rehabilitation. 21st century medicine has seen a resurgence of integrative therapies combining pharmaceutical intervention and lifestyle modification, with Chiatow's 2008 publication largely creating the conditions for a resurgence of broader applications for physiotherapy and manual therapy.

It is because of the work of the authors mentioned above, and others, that I have built a primary care medical practice over 12 years which specializes in the physical treatment of disease.

Patients are seen in an outpatient setting, and prescribed a range of therapies specific to their case which can include; pharmaceutical prescription, natural medicinal agents (herbs, nutrient concentrates, etc), dietetic plans, lifestyle counseling, and courses of manual and physiotherapy using the methods detailed in this report as well as others as the case may dictate.

Therapies

The following is by no means an exhaustive list of physiotherapy techniques that regularly are applied in my clinical practice. I have highlighted a few specific physiotherapy applications and their techniques as they are pertinent to the case summary below.

Low-Volt Alternating Current (LVAV)

Classically known as a «Sinusoidal» current, modern advances have standardized asymmetrical alternating currents with a maximum output of 110 V. Though many waveform patterns can now be utilized, the sinusoidal waveform is most consistently used in my practice. Machines alternate their frequency range from 50 – 1,000 oscillations per second and current can be applied continuously or in surges with rates that can be set by the practitioner. Typically used as a muscle stimulator or as transcutaneous pain control, the LVAV current can be used in a variety of other applications. Standard application is done with 2 electrodes either directly applied with a self adhesive or delivered through a moistened sponge. Applications in wound healing, pain control, and edema reduction are well reported and a detailed review is beyond the scope of this report [3, 7-13]. In addition, currents have been applied to aid in metabolic and digestive conditions for over 100 years [3, 4].

Galvanic Iontophoresis

The use of polarized direct current (Galvanic) is the oldest form of electrotherapy in practice. By using a positive anode and negative cathode, a unidirectional/direct current is run between the two positions. Applications of direct current are used in wound healing, and more recent studies have shown biophysical effects of the current at the cellular level which give modern insight into some of the classical applications [9, 12, 14]. Typically, galvanic current is paired with medication that is driven into a tissue space by either the cathode or anode, depending on the polarity of the drug substance in question. For our purposes we will be reviewing the iontophoresis of Silver ions with the anode [3, 5-7, 9, 12-16].

Pulsed Shortwave Diathermy (PSWD)

Shortwave Diathermy is applied over a region of the body inducing a very high frequency electro-magnetic field. The rapid oscillations of the field stimulate tissue and causes a heating of the area. The conductance of the tissue being treated will affect the depth of penetration/ dissipation of

heat. [3, 5, 6]. The heating of the tissue confers the traditional benefits of hyperthermia, namely improved oxygenation, activation of heat shock proteins, and increased immune cell activity [3, 5, 6, 17]. Pulsed Shortwave Diathermy is applied in an interrupted fashion which can be set at different variables from 1-12. The pulsed action of the field creates a pumping effect to the perfusion of the tissue and is shown to improve wound healing [17-20].

Case Report

This is a case of a 78-year-old female, retired pediatrician. She presented to the clinic in September of 2019 with a 2-year history of non-healing foot ulcer on the anterior aspect of the plantar surface of her right foot, just proximal to the digits.

The initial work-up included a comprehensive physical examination, records review, dietetic program, and prescription of herbal and nutrient based medication. Due to insurance issues, the patient was refusing to follow through with recommended blood work and imaging.

Her initial ulcer first presented 2 years prior. It had been diagnosed and managed as a structural abnormality of the foot due to a poorly positioned sesamoid bone on the 1st metatarsal. Surgical intervention had been initiated to cut the flexor hallucis longus tendon, thus relieving pressure to the region during ambulation. Due to a recurrence of the ulcer post-surgery, further work up was initiated which revealed an uncontrolled NIDDM – the true cause of the ulceration. She had been prescribed metformin 500mg twice daily and was following a self-prescribed low sugar diet for 6 months, with moderate reduction of her HbA1c upon last blood work.

Upon her presentation at the clinic a physical examination of the region in question revealed an approximately 8 cm x 5 cm significant callous on the anterior plantar surface of the foot with a 5 cm fistula at the medial aspect. Purulent discharge was present at the site of the fistula. The patient had been managing the wound care procedures at home since her last visit with her orthopedic surgeon. She refused any follow up visits with him.

Consultation with the patient's orthopedic surgeon confirmed that as of her last MRI she had a chronic ulceration secondary to uncontrolled NIDDM, with a high suspicion for osteomyelitis and osteonecrosis. She was presented with amputation of the distal half of her right foot as her only treatment option, and hope to prevent further tissue necrosis, and potential proximal spread of osteomyelitis and osteonecrosis. The patient has refused amputation.

Primary interventions prescribed after her initial workup included control of Diabetes through use of natural / herbal / homeopathic medications alongside maintaining her metformin schedule, a structured program of dietetics and the use of comprehensive physiotherapy twice weekly to enhance tissue regeneration.

Physiotherapy protocol

1. Contrasting half-torso hydrotherapy packs:

- Initiated with an application of wet heat for 5 minutes to improve capillary bed perfusion, increase oxygenation, and stimulate metabolic activity;
- Applied over the abdomen and chest from the clavicles to the ASIS with an approximate width of 25 cm;
- Followed by a warming compress covering the same region;
- A towel is wrung out in cold water, applied over the region from where the hot compress has just been and covered with an insulating rubber sheet;

- This is left in place for approximately 10 minutes in which time the towel warms to body temperature.
 - This process regulates autonomic nerve function through vascular-neurological reflexes, constricts capillary beds thus shunting the metabolically rich blood to deeper organ systems, and eventually relaxes the capillary bed constriction through the gradual reactive warming of the cold compress. This process creates a synchronizing effect on the autonomic-circulatory-organ systems [1-3]. After the following steps are completed, the same treatment of Contrasting half-torso packs is applied to the back from C7-L5 with an approximate 25 cm width.
- 2.** LVAC is utilized first at the para-spinal region at the T5 level.
- This stimulation is surged at about 12 cycles per minute, and the intensity of the current is brought to a comfortable level for the patient, but one that does not allow for muscle contraction.
 - The stimulation causes depolarization to the spinal nerve roots, stimulating among other digestive functions, peristalsis which can be experienced by the patient [3, 4, 6].
 - After 10 minutes the LVAC location is changed to one placement on the lumbar-sacral junction and the other just superior to the navel.
 - The surge cycle and intensity are set as above. From here we see stimulation of the lymphatics of the abdomen that has been associated with elevated white blood cell peripheral circulation in yet to be published work [3].
- 3.** This combination of applications, which can be run simultaneously and, in addition, the stimulation of certain acupuncture points would be a typical prescription for general metabolic care. In this case due to the poor peripheral circulation, a non-surged constant current was applied through the right leg, with one placement at the R hip and one under the R foot. This intensity for this application is set to a stronger setting creating a contraction in the calf muscle. Limb applications as described herein will improve tissue perfusion, lymphatic movement, and venous return [11].

Within one month under regular treatment the fistula was closing. Patient refused debridement of the callous to preserve ambulation. Gradually fluid accumulation behind the callous became apparent. Patient discontinued ongoing treatment and observation from November 20th until January 3rd of 2020 when she presented to the clinic with a rupture of the callous. Debridement of the calloused skin revealed a 6 cm x 3 cm ulcer with clear signs of necrotic tissue. The patient's right calf was suspect of cellulitis and a likelihood of osteomyelitis in the foot was high. At this point the patient agreed to diagnostic testing and imaging. Her blood work showed obvious signs of infection and anemia. Her MRI confirmed the ulceration and soft tissue damage and determined likely osteomyelitis along 2nd and 3rd metatarsal bones with noted destruction of the bone and anterior tendon structures. The MRI also revealed a likely abscess along 3rd metatarsal and probable cellulitis was also noted.

The patient was prescribed an antibiotic course of Cephalexin and treated acutely for wound care and infection using the following physiotherapy protocol:

1. Hydrotherapy was applied as described above;
2. Galvanic Iontophoresis of Oligodynamic Silver: Sterile gauze is saturated in silver solution and applied

directly to the ulcerated region, after the region had been aseptically prepared. A positive anode is attached to the gauze and everything is secured in place; in this treatment this is the active electrode. A negative cathode is attached to a sponge that is approximately 4x as large as the silver started gauze in surface area; this is the dispersive electrode. This is attached to the patient right calf, concentrating the strength of the polarized current in the active electrode. Current is run at 2 mA for 30 mins. The current combined with the silver iontophoresis has a marked direct antibiotic effect [5, 9, 12, 14, 15];

3. The wound is then managed with conservative wound care measures described below;
4. Pulsed Shortwave Diathermy: Once dressed and bandaged, the area of the wound is placed in the field of the PSWD. A 10 minute cycle of heating is applied in which there is no pulsing of the Shortwave field. A second phase of pulsed application is then applied for 15 mins at a 1-10 pulse setting.

The patient was seen every day until the visual signs of infection reduced, for a total of 8 treatments. She was then seen 3 times weekly with the same protocol. In addition, conservative wound care management was applied at every treatment consisting of:

1. Aseptic preparation of the ulcerated tissue and surrounding area with 10% iodine swabbing x3 performed at the very start of the visit and reapplied before the following steps. Debridement of necrotic or calloused tissue;
2. Medi-Honey applied directly to the ulcer to encourage autolytic debridement; approximately 5 ml;
3. Silver mesh wound dressing cut to fit the ulcer applied over the region to maintain bacteriostatic environment;
4. Hydrogel covering all applications to maintain hydration of the region;
5. A sterile non-adherent dressing was placed over the site and tape cast into place;
6. Sterile gauze wrap to the foot was then applied to hold the dressing in place for up to 72 hours.

After 3 treatments, including debridement of necrotic tissue from the ulcer, healthy granulation was apparent and the size of the ulcer was reducing. By the 12th treatment under the new procedure the ulcer had reduced to 4 cm x 2 cm and the head of the 2nd metatarsal began to protrude from the wound. Confirmation of infection control and stabilization of anemia was obtained at this visit per blood work.

After one month of treatment, now reduced to twice weekly, a 2 cm x 1 cm segment of the 3rd metatarsal head was expelled from the wound showing signs of severe destruction to the bone matrix.

2 months more of twice weekly treatments, as described above, continued until the ulcer was closed. The patient was then switched to twice monthly maintenance physiotherapy for ongoing blood sugar stabilization and peripheral circulation support. This protocol mirrored her initial physiotherapy prescription. Minor ulceration would appear and resolve depending on activity level of the patient, who was awaiting a consultation for new orthopedic foot wear. Patient maintains course of dietetic and natural therapeutic medicines to support blood sugar control as well as a 500 mg once daily dose of Metformin, her HbA1c was 5.8% at the point she was switched onto maintenance care. She maintains conservative ambulation with supportive footwear alongside a regular routine of home exercise and hygiene.

Conclusion

This case exemplifies how the scope of physiotherapy intervention, as has been codified over the past century, can and should be considered as part of primary intervention and rehabilitative care. Physiotherapy programs can be implemented at any stage of care from acute/urgent care needs to chronic rehabilitation, and general maintenance and preventative care. Physiotherapy pairs well with dietetic, lifestyle, and even pharmaceutical interventions because fundamentally the therapies enhance tissue and organ function, allowing for better delivery of nutrients and medications and better removal of exudate and tissue wastes.

Understanding the scope of applications, the biophysical effects of different therapies, as well as differing techniques within a particular therapy, provides health professionals a wide range of tools at their disposal for more effective treatment outcomes. Further training programs are needed to educate health professionals in the effects of the therapy, and perhaps more importantly how to consider the tissue pathology associated with the diagnosis being treated.

Correctly assessing the tissue pathology present in the patient is the manner by which effective physiotherapy applications are selected.

A primary care model, inclusive of a physiotherapeutic core, has the ability to assess and treat patients from a multi-system perspective, consult and coordinate care with specialists and other healthcare team members, and ultimately provides a more robust and comprehensive healthcare experience for the patient being treated. In this case, the prospect of not requiring foot amputation was motivation for the lifestyle changes that, supported by a program of physiotherapy, ultimately were at the core of keeping the ulceration and general tissue pathology under control.

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Contribution:

Coplin M. – this is a presentation of a case that was treated under the author's care while working as the attending physician at the Portland Clinic for Holistic Health. Case examination and prescriptions were managed by the author. The summary of this case was collected and reported by the author. Background research and clinical citations for this case review were all collected by the author.

