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Effect of Physical Therapist Management using Pulsed Short-Wave Diathermy for a Stage III Sacral Pressure Ulcer in a patient with Alzheimer's Dementia: A 4-Week Study in a Skilled Nursing Facility: Case Report.

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Abstract: Background and Purpose

Alzheimer's disease (AD) is the most common cause of dementia which results in progressive decline in memory, cognitive and functional abilities of patients. Pressure ulcers are a common complication in patients with AD in skilled nursing facilities (SNF) and contribute significantly to the mortality rate.[1, 2] Pulsed short wave diathermy (PSWD) treatment has been shown to promote faster healing of pressure ulcers.[12] The purpose of this case report was to examine the effect of PSWD treatment on Stage III sacral pressure ulcer healing and its impact on sitting balance in an 80 year old female with advanced AD residing in an SNF.

Case Description

The patient was an 80-year-old female with stage 6 AD and a Stage III sacral pressure ulcer.

Intervention

The patient underwent 16, hour long physical therapy sessions over 4 weeks focused on localized PSWD treatment for wound healing alongside interventions to improve muscle strength, sitting balance, posture, and positioning.

Outcomes

Patient's sacral ulcer improved to Stage III healed, evidenced by 100% eschar and no slough tissue. Pain

was effectively managed, with a final Pain Assessment in Advanced Dementia (PAINAD) score of 0. The patient's Braden Scale for Predicting Pressure Sore Risk (BRADEN) score improved to 18, indicating reduced risk for skin breakdown. The patient's Function in Sitting Test (FIST) score improved to 46/56, indicating improved sitting balance.

Discussion

This case report demonstrates that PSWD facilitates faster wound healing and improved pain management in patients with AD. This case report encourages future research to validate the efficacy and safety of PSWD in similar patient populations.

Keywords: Geriatrics, Physical Therapist management, Alzheimer's Disease (AD), Pressure Ulcer, Sacral Ulcer, Pulsed Short-Wave Diathermy (PSWD), Skilled Nursing Facility (SNF).

BACKGROUND AND PURPOSE: INTRODUCTION

Dementia refers to a diffuse progressive decline in a patient's mental function presenting with deficits in thought, memory, feeling and conduct. Impairments in patient's judgment and reasoning are usually the earliest changes.[13] Alzheimer's disease (AD) is the most frequent cause of dementia. Key neuro-pathological changes associated with AD include diffuse and neuritic extracellular protein fragments, beta-amyloid plaques and intracellular neurofibrillary tangles, resulting in brain cell damage. These are accompanied by reactive microgliosis and loss of neurons, white matter and synapses.1 The etiology of AD is unclear, but research points to both environmental and genetic factors. In the United States, it is estimated that AD afflicts nearly 4 million people and is the fourth leading cause of death.[2]

There are seven stages of AD.[3] With advancing stages, symptoms manifest as the patient becomes careless with dressing and personal hygiene and finally becomes incontinent with the bladder and bowel. The patient's speech progressively worsens and finally becomes incomprehensible and jargon-like. Weight loss and significant physical deconditioning with concomitant impairment of sitting and standing balance are inevitable. Finally, the patient is unable to respond to the physical environment, leading to a myriad of complications. Currently, AD is incurable, and treatment is focused on slowing disease progression. In addition, a patient's symptoms are managed with pharmacological (cholinesterase inhibitors and memantine) and/or nonpharmacological agents.

Among the various complications associated with AD, integumentary integrity issues i.e. pressure ulcers significantly contribute to overall morbidity and mortality. Pressure ulcers are caused by unrelieved external pressure, friction or shear force against the patient's skin, commonly over bony prominences (e.g. the heels, sacrum, elbows, and posterior cranium) resulting in localized ischemia and/or necrosis of the underlying tissue. Patients with AD present with significant progressive cognitive impairments rendering them unable to respond to external noxious stimuli, which when coupled with concomitant urinary and bowel incontinence issues put them at higher risk for skin breakdown. Other risk factors for pressure ulcer development include damage to the nervous system and loss of sensation as seen in other diagnoses such as CVA, SCI, TIA, diabetes, vascular disease, malnutrition, ageing, and smoking5. Patients with AD and any of these co-morbidities have an even higher risk of pressure injury. Pressure ulcers have significant potential to enlarge quickly and if untreated, often lead to cellulitis, infection, osteomyelitis, gangrene, sepsis and fatality. As illustrated in Table 1, pressure ulcers are categorized from stage I to stage IV based on the extent of skin and tissue destruction.[6, 7]

Based on a randomized controlled trial in nursing homes conducted by Bergstrom, Horn, et al., pressure ulcers increase the rate of patient death by as much as 400%, increase hospitalization rate and decrease quality of life.8 Research also shows that the presence of pressure ulcers in patients with AD admitted to SNFs contributes significantly to the overall mortality rate, which is approximately 50% with a first year rate of 25.7%.[1, 2] In addition, the presence of pressure ulcers is one of the independent predictors of death.[2]

The National Pressure Injury Advisory Panel (NPIAP) outlines how pressure ulcers are managed which includes the following: determining pressure ulcer classification, assessing and monitoring wound healing, providing nutritional support, performing pain

assessment and management, providing support surfaces and repositioning strategies, performing wound bed preparation including cleansing, debridement and dressings, performing assessment and treatment of Infection and use of biophysical agents and surgical interventions.[7] Among the biophysical agents, short wave diathermy falls under electromagnetic spectrum utilizing radio frequency wave bands of 27.12 MHz which primarily produces heat in subcutaneous tissue up to depths of 3-5cm. By incorporating a timing circuit, PSWD is obtained which alters the carrier frequency to range between 26.95 MHz to 27.28 MHz. The pulse frequency is 400 pulses per second and pulse length ranges from 25 µs to 400 µs. Pulsed electromagnetic energy (PEME) provides an energy boost to tissues in the form of an electromagnetic field without heat generation. It improves enzyme and phagocytic activity as well as cross-membrane transport by stimulating ions, molecules, membranes and cells. In damaged cells, PEME facilitates the restoration of normal cell potential by influencing the ion flow.[14]

The physiological effects of PSWD treatment can be summarized as an increment in the white blood cells and fibroblast count in an ulcer, improved rate of dispersion of edema and re-absorption of hematomas, resolution of inflammation, increased deposition and organization of collagen and fibrin, stimulation of osteogenesis and improved blood flow ultimately leading to acceleration of the swound healing process.[10] Systematic review conducted by McGaughey, Dhamija et al, suggests that there is moderate evidence (Level 2) when combined with standard wound care practices. PEME has been significantly more effective in healing wounds, both in terms of faster median times of healing and greater wound surface area healed.[10, 11] A review of existing clinical trials by Shields, Gormley and O'Hare has specifically pointed out that PSWD assisted treatment leads to 100% healing of pressure ulcers in just twenty-five % time compared to regular wound treatment time.[12]

However, the current literature does not illustrate the effect of PSWD in the management of wound healing in patients with cognitive impairments. The purpose of this report is to examine the effect of pulsed short wave diathermy treatment on Stage III sacral pressure ulcer healing and the subsequent impact of ulcer healing on sitting balance in an 80-year-old AD patient who is a long-term resident of a skilled nursing facility.

CASE DESCRIPTION

The patient in this case report was an 80-year-old female diagnosed with stage 6 AD, who had been a long-term resident at an SNF for the past 4 years. She was referred to the Physical Therapist by a wound specialist physician for management of her stage III sacral pressure ulcer after topical medications and wound dressings did not yield the desired effect on wound closure and healing. The patient's daughter, who was the responsible party, agreed to document the patient's episode-of-care as a case report for academic and research purposes. Because the patient was a long-term resident at an SNF, which is a locked Alzheimer's care facility, no additional consent was required for the release of information.

Prior to the patient's admission to SNF, she lived with her daughter until her dementia became unmanageable. At the start of this case report, the patient was only oriented to herself, demonstrating significant cognitive impairment. She was mostly wheelchair bound, although when willing, could unsteadily ambulate short distances using the back of her wheelchair with the nursing staff. Prior to her initial admission to the SNF, the patient was an independent ambulator without any assistive device but had started to wander out of her daughter's home putting her at risk for injury and/or elopement. In younger years, she was primarily a home maker and raised her only daughter. The patient's spouse had been deceased for the last 15 years.

The patient's past medical history included Alzheimer's Dementia, Hyperlipidemia, Metabolic Encephalopathy, Non-ST-segment elevation Myocardial Infarction (NSTEMI), Dysphagia, Heat stroke, and a healed thoracic vertebral compression fracture. There was no history of cardiac pacemaker placement, metal implants or any other surgical procedures. In addition, there was no history of cancer/malignant tumors, tuberculosis and/or Deep vein Thrombosis (DVT), which allowed the administration of PSWD treatment for the management of her pressure ulcer.

Electrical stimulation treatment was ruled out, as this patient had a prior history of not tolerating these treatments, wherein treatment had to be abruptly ended because of the patient's emotional and mood lability issues (during a prior episode of care). The patient had no history of smoking, alcohol consumption or recreational drug use. Her prescribed medications were Aspirin 81 mg for MI, Atorvastatin ten mg for Hyperlipidemia, Donepezil 5mg for Dementia, Milk of Magnesia 400mg/5ml: 3 ml for bowel movement, Ipratropium-Albuterol: 1 unit dose for Shortness of Breath, Namenda 10 mg for Dementia and Vit. C and Vit. D supplements. The patient's diet was regular and was on thin liquids with no other restrictions.

During the initial physical therapy evaluation, the patient presented with a Stage III sacral pressure ulcer over the fourth vertebra accompanied by continuous mild pain as evidenced by the PAINAD score of three in Table 2. Per nursing, the patient developed this ulcer five months prior. The patient also presented with impaired muscle strength and sitting balance. The physical therapy goals included addressing integumentary integrity with PSWD, improving the patient's muscle strength and improving sitting balance supplemented by general postural education pertaining to the patient for the nursing staff.

Ethics

Informed consent from patient's responsible party was obtained before initiating the course of physical therapist management. Health Insurance, Portability, and Accountability Act requirements were also maintained during this process.

EXAMINATION AND EVALUATION

A comprehensive PT Evaluation was performed, which included re-confirming the Physician's referral, performing patient's medical chart review including reviewing her prescribed medications and laboratory values, primarily Hgb, Hct, WBC, Platelets, INR, PT/PTT, Urine Glucose and Creatinine. All laboratory values were normal except for Hgb, which was slightly decreased to 11mg/dL. In addition, patients' vitals were assessed, prior level of function (PLOF: 6 months prior) information was gathered, and contraindications and precautions for planned PT treatment were obtained. This was followed by an evaluation of the patient's physical and integumentary status.

The patient's vital signs were as follows: blood pressure: 122/84 (mm Hg), heart rate: 74 (bpm), respiratory rate: 18 breaths/min, Spo2: 97% on room air. She was alert but was confused and oriented only to herself. The patient's integumentary evaluation summarized in Table 3 included visual skin inspection yielding a Stage III pressure ulcer on S4/coccyx6. Initial wound measurements were taken: 0.5 cm L x 0.3 cm W x 0.1 cm D with 0.15 cm2 area. Significant slough tissue was present with a moderate amount of serosanguineous discharge. Localized erythema was present; however, the wound did not show any active bleeding or eschar. She also presented with 1+ peripheral edema in both the lower extremities. A bilateral pulse examination of the dorsalis pedis (DP) and posterior tibial (PT) arteries was performed and determined to be 2+ (easy to palpate). The patients' anthropometric data were as follows: height: 4 feet 8 inches and weight: 142 lb. Consequently, her body mass index (BMI) was 31.83, indicating that she was obese. The patient's peripheral nerve integrity was assessed via + 5.07 Semmes-Weinstein monofilament testing and was found to have an intact protective sensation. The patient's motor function evaluation results were as follows, Bilateral upper extremity (UE) and lower extremity (LE) Active Range of Motion (AROM): within functional limits. Bilateral UE and LE muscle strength was impaired as evidenced by manual muscle testing (MMT)21 grade of grossly 3/5. She also presented with generalized kyphosis with bilateral flexed hips and knees posture. The patient's neuromuscular assessment revealed intact cranial nerve integrity and deep tendon reflexes.

The pt required minimum manual assistance for bed mobility, sit<>stand and stand pivot transfers during her functional mobility assessment. Surprisingly, she agreed to attempt assisted ambulation, albeit with the support of the back of her standard wheelchair: she ambulated up to 10-15 feet with moderate manual assistance. She consistently refused to use any other assistive device and became agitated when encouraged to use a wheeled walker instead of the back of her wheelchair. Nevertheless, the patient was mostly wheelchair

dependent for functional mobility, and nursing staff provided all functional care to the patient including perineal hygiene. The patient was independent for slow propulsion of her standard manual wheelchair indoors.

The patient also presented with significant deficits in communication, affect, cognition, language and learning styles related to Stage 6 AD[3]. She required prolonged time for processing simple, one step commands, demonstration of desired activity and repeated visual, verbal and tactile cues to stay on therapeutic tasks.

The primary outcome measures used to track the effectiveness of PSWD as a treatment for pressure ulcer healing were PAINAD, BRADEN and FIST. When asked multiple times for complaints of pain, she held her sacral area. The PAINAD score was determined to be 3. The patient's BRADEN score was recorded at 14 i.e. Moderate Risk as illustrated in Table 4. Her sitting balance was tested using FIST, wherein she scored 22/56 as illustrated in Table 5.

PAINAD score:[15] It is a simple, valid, and reliable instrument for measuring pain in non-communicative patients. Breathing, negative vocalization, facial expression, body language and consolability are rated from scores of 0 to 10 with final scores of 1 to 3 indicating mild pain, scores of 4 to 6 indicating moderate pain and scores of 7 to 10 indicating severe pain. Previous studies have revealed adequate level of inter-rater reliability. This scale can also detect statistically significant differences between scores obtained before and after receiving pain medication.

BRADEN scale:[16] This scoring system is used to evaluate the risk of a patient developing a pressure ulcer. The score is based on 7 risk factors measured on six subscales: sensory perception, activity, mobility, moisture, nutrition, and friction/shear. Each subscale scores range from 1 to 4 except for the friction/shear subscale, which ranges from 1 to 3. The risk is based on a score of 6 to 23 with lower scores indicating greater risk and vice versa. The inter-rater reliability coefficients in SNFs16 yield r = 0.83 to r = 0.99 (P < .001). Predictive validity has been established at 83% sensitivity and 64% specificity, with a NPV of 85% and a PPV of 61%, based on a cutoff score of 16.

SMU function in sitting test (FIST):[17,18,19] This test is used to examine sitting balance, select treatment interventions and track changes in patients' sitting balance over time. The FIST consists of 14 functional activities as test items which are scored on a 5-point ordinal scale ranging from zero (lowest ability) to four (normal ability). The studies establish minimal detectable change (95% confidence) at 5.5 points, Test-retest reliability (ICC, 95% confidence) of 0.97 and Inter-tester and intra-tester reliability (ICC 95% confidence) of 0.99.

INTERVENTION

A total of 16 physical therapy treatment sessions, each lasting 60 minutes, were provided for the patient for 4 weeks. PSWD coupled with therapeutic exercises for patient's stage III sacral ulcer was selected as the treatment intervention.

Pulsed Short Wave Diathermy treatment at the patient's sacral ulcer site was administered using the SWD Unit as follows: the patient's clothing was removed at the local site along with dry dressing by the patient's wound nurse. She was positioned in a side lying position on a therapy mat table in the rehabilitation gym and a sub-thermal dose was applied via a drum type application using the inductothermy method at the following protocol: Carrier frequency 27.12 MHz, 400 pulses per second pulse frequency, 65 µs pulse duration, 4% duty cycle for 30 minutes, four times/week for 4 weeks. An average power of 3.9 watts/session was delivered. After each PSWD treatment session, the patient's wound nurse applied triad paste and dry dressing as prescribed by the patient's wound care physician.

The next 30 minutes of the PT treatment session aimed to strengthen the patient's bilateral UE and LE and core strength. Dynamic sitting balance training was also provided to the patient via seated functional activities to improve her overall functional mobility and safety during seated activities of daily living (ADL).

Postural education for the patient and nursing staff was provided to facilitate correct positioning, biomechanics and prevent further integumentary disruption. Pressure relief maneuvers in the bed and wheelchair were also instructed and emphasized. The patient was also

provided with a ROHO cushion for her wheelchair and a low air loss (LAL) mattress for her hospital bed. Adequate training was provided to nursing staff to facilitate optimal patient compliance. Additionally, inter-disciplinary team communication was also performed including referral to the nutritionist to establish a balanced diet to aid the patient's sacral ulcer healing.

Pre and post 4-week scores were obtained for each functional measure: Pressure Ulcer staging, the PAINAD score, BRADEN score and FIST sitting balance score. The PT treatment interventions provided to the patient aimed at improving sacral wound healing and concomitant improvement in the listed outcome measures.

OUTCOMES

Patient outcomes after four weeks of physical therapy are summarized in Table 6. The patient's stage III sacral pressure ulcer over fourth vertebra was fully healed. The wound presented with 0% slough, 0% granulation tissue, 0% necrotic tissue, 0% hyper-granulation tissue, and 100% eschar formation. There was no undermining or tunneling with no signs and symptoms of infection. The patient's sacral area pain improved, as evidenced by the final PAINAD score of 0 from the initial score of 3.

The patient's BRADEN score improved from an initial score of 14 to 18, now categorizing the patient into a mild risk category for skin integrity issues. The patient's sitting balance score also improved as evidenced by the final FIST score of 46/56 from the initial 22/56, thereby reducing the patient's risk of falling and improving the dynamic stability during seated ADLs.

The patient also benefitted from therapeutic strengthening exercises and functional activities as evidenced by improved manual muscle testing scores ranging from 3+/5 to 4-/5 from the initial 3/5 score. The nursing staff's training regarding patient's adequate pressure relief, proper positioning in bed and wheelchair, and optimal nutritional support was completed to facilitate the patient's safe follow-through to prevent exacerbation of the sacral ulcer and to prevent decline in the patient's overall functional status.

DISCUSSION

At the end of 4 weeks of PSWD treatment, the patient demonstrated a Stage III healed ulcer and concomitant pain relief, similar to the results of the research conducted by McGaughey, Dhamija et al.[10]. The patient also demonstrated improved positioning, posture and ability to relieve pressure when in bed and wheelchair. This was the result of the patient's improved FIST score and overall muscle strength leading to improved dynamic stability and improved BRADEN score further minimizing the risk of sacral ulcer re-formation. This was supported by research conducted by Cox, J.[16] and Gorman, Platko, et al.[18]

It is imperative to mention that dedicated functional care and adequate patient supervision by nursing staff are critical for these improved functional measures in lieu of patient's significantly impaired cognition. However, a limitation of this case report is that in addition to PSWD treatment, concurrent wound treatment by nursing staff was also administered during this episode of care i.e. application of triad paste and dry dressing by nursing staff twice daily for 4 weeks. Additionally, the nursing staff had to closely supervise and facilitate the patient's turning schedule, proper positioning in the bed and wheelchair, perineal hygiene and nutritional support. A host of other physical therapy interventions aimed at improving the patient's sitting balance, posture, positioning and overall muscle strength were also administered to the patient in each of the 16 PT sessions conducted.

Therefore, it is imperative that further research and case studies are conducted, possibly in a more controlled environment than SNF, to discern whether PSWD treatment could be the mainstay of wound healing treatment interventions rather than a significant adjunct modality. The critical factor is the support that the patient required, especially during the rest of the day, wherein nursing staff had to demonstrate high dedication and commitment to closely supervise and facilitate the patient's correct positioning and pressure relief. Moreover, the absolute need for adequate nutritional support to improve the wound healing process cannot be undermined.

Nevertheless, the desired patient results were obtained, and this case report demonstrates that the use of PSWD in patients with AD with significant cognitive impairment leads to improved wound healing. The sacral ulcer lingering and worsening over the previous five months healed after 16 PT treatment sessions.

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