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14. ABSTRACT

25~30% Gulf War veterans suffer Gulf War Illness (GWI) have one or more chronic symptoms such as fatigue, musculoskeletal pain, and memory and/or mental problems. These symptoms significantly interfere with their motor function and quality of life. The purpose of this study is to provide symptomatic veterans with acupressure treatment and determine its effectiveness in fatigue relief and pain management for GWI disease. RESULTS: Four subjects have completed the study protocol (two subject for Acupressure and two for Reiki). The results look promising and are indicative of the Acupressure potential for pain management and fatigue relief in veterans with GWI. Pain scale and fatigue scale decreased during the intervention. EMG data in both groups shows increased mean EMG power after the fatiguing task. EMG power differences became smaller for acupressure group, especially for FDI and ED muscles during the treatment period. EEG power spectra offer a quantitative realization of which frequencies contributing to the overall signal in brain output. EEG showed that acupressure patients exhibited lower theta band EEG power, relative to before treatment, while Reiki group did not how such relationship. In comparison to their pre-treatment levels, the increase in CMFC for 12 pairs strongly suggests that continuing acupressure treatment, in addition to routine clinical care, has a positive effect on brain-to-muscle descending motor signal. This knowledge may lead to further refinement of the protocol as well as advancements in acupressure intervention for veterans with GWI.

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Introduction

About 25~30% Gulf War veterans suffer Gulf War Illness (GWI), with one or more chronic symptoms (i.e. debilitating fatigue, chronic headache, muscle and/or joint pain, sleeping problems, etc.), lasting six months or longer, in at least two of three categories: fatigue, musculoskeletal pain, and memory and/or mental problems. These symptoms significantly interfere with their motor function and quality of life (QOL), preventing them from doing daily work normally or enjoying social and recreational activities. The etiology of GWI, however, is still elusive currently; hence there is no established conclusive treatment. Veterans with GWI rely on pharmaceutical treatment, physical therapy, and/or nutritional supplements to temporarily alleviate their symptoms, with limited effect. The severity of symptomatic health of veterans with GWI does not change much over time and very few veterans have ever recovered significantly. This study provided symptomatic veterans with acupressure treatment and determined its effectiveness in fatigue relief and pain management for GWI disease. Patients who had reported experiencing symptoms of GWI were enrolled and randomized into acupressure group (to receive acupressure treatment) and control group (without acupressure treatment). Patients were received 40 min acupressure treatment or Reiki treatment, twice per week for 6 weeks. Evaluations were made before and after treatment, and clinical outcomes were compared between two groups (acupressure group vs. control group) and between different stages (before treatment vs. after treatment) within the same group. The study focused on two areas: 1) To investigate the effectiveness of acupressure for fatigue relief and pain management in veterans with GWI; and 2) To investigate the relationship between EEG measures, specifically the corticomuscular coherence and power spectra in theta band, and the clinical measures.

1. Keywords

Gulf War Illness (GWI), Acupressure, Reiki, Pain Management, Fatigue, Quality Of Life (QOL)

2. Overall Project Summary

Four veterans with GWI were enrolled and randomized into 2 groups (acupressure vs. control). Both groups received routine clinical care, with additional 12 sessions of acupressure treatment offered to the acupressure group and dosage matched reiki treatment offered to the control group, respectively. Clinical outcome measures include Study Short Form 36 (SF-36) for quality of life evaluation; revised Piper Fatigue Scale for fatigability evaluation (rPFS); and Brief Pain Inventory (BPI) for pain evaluation. Objective measures included EMG and force indices during motor tasks before and after treatment, electrophysiological evaluation of corticomuscular coherence among different cortical areas and muscles, and spectral analysis of different EEG frequency bands. Evaluation was performed at the beginning of, in the middle of, and immediately after the treatment, and 4 weeks after the conclusion of the treatment. Results were be compared between groups and among the different evaluation stages within the same group.

<u>Clinical measurements.</u>
The table below showed the clinical outcomes for both groups.

Tests		Acupressure			Reiki		
		Baseline	After	follow up	Baseline	After	follow up
BPI	pain severity	3.84	3.00	4.61	6.67	5.25	6.25
	pain interference	7.34	6.65	7.32	7.21	4.5	5.92
rPFS		7.09	6.39	6.84	4.66	4.57	4.43
SF-36	physical function	25	27.5	22.5	15	20	35
	role limitation due to physical health	0	12.5	0	0	0	0
	role limitation due to emotional health	33.33	33.33	0.00	33.33	83.33	33.33
	Energy/Fatigue	17.5	27.5	20	27.5	32.5	30
	Emotional well being	40	44	38	70	60	68
	Social functioning	37.5	50	43.75	56.25	50	56.25
	Pain	28.75	33.75	22.5	27.5	33.75	33.75
	General health	47.5	40	37.5	32.5	35	37.5

For Acupressure group, the baseline scores were 4.1 for BPI and 5.7 for rPFS, respectively. After 6 weeks of the acupressure treatment, the scores decreased to 3.5 for BPI and 4.5 for rPFS, respectively. When the treatment was discontinued for four weeks, these scores had the following increments (BPI, 5.2; rPFS, 6.0). In comparison, in Reiki group, the baseline scores for BPI and rPFS were 5.9 and 5.5, respectively. After 6 weeks of the Reiki treatment, the scores were 2.8 for BPI and 4.5 for rPFS, respectively. When the treatment was discontinued for four weeks, these scores had the following increments (BPI, 5.6; rPFS, 6.5).

Clinical outcomes showed that a 6-week acupressure intervention produced fatigue relief and pain alleviation. This indicates that acupressure may be a potential noninvasive therapeutic technology for fatigue relief and pain management in veterans with GWI. These similar results were also observed in Reiki group. Because of the limitation of the sample size, no significant difference was observed. Continuation of the study would allow us to better understand the efficacy of acupressure for fatigue relief and pain management in veterans with GWI. This knowledge may lead to further refinement of the protocol as well as advancements in acupressure intervention for veterans with GWI.

EMG and Force: Peak handgrip force was measured in each trial, and then averaged across trials for each task (NFT and FT) for each subject. The average peak force was normalized to the peak force of MVC1. A group average of the normalized NFT and FT force was then be determined for each subject group. EMG signals (after rectification) of each measured muscle were averaged and normalized to the maximal level the same way as force (except that for EMG, an average value over a 1000-ms period is derived instead of the peak value in force).

EMG data was collected on three muscles (FDI, FDS and ED) which were prominently active for our voluntary handgrip task. Both groups showed increased mean EMG power after the fatiguing task. EMG power differences became smaller for acupressure group, especially for FDI and ED muscles during the treatment period. Groups did not show normally distributed force exerts between and/or within trials. In comparison to their pre-treatment levels, the alleviation in EMG

power for fatiguing tasks indicate acupressure offers an alternative fatigue relief treatment, in addition to routine clinical care.

EEG data: Spectral Analysis EEG power in theta band was used to evaluate the severity of pain and mental problems and predict the outcome of treatment. Spectral analysis using fast Fourier transform (FFT) was performed on raw EEG data in each B1, MVC1, NFT, FT, MVC2, and B2 segments. For each trial, a power spectrum was calculated, and the power for each of the following standard EEG frequency bands were derived: delta (0.5–4 Hz), theta 4–8 Hz), alpha1 (8–11 Hz), alpha2 (11–14 Hz), beta1 (14–25 Hz), and beta2 (25–35 Hz). The relative power of each band as a percentage of the total power was calculated. Subsequently, the mean relative power of each band across the number of trials (e.g., 30 trials of the NFT) is obtained.

EEG power spectra offer a quantitative realization of which frequencies contributing to the overall signal in brain output. Theta frequencies (4-8 Hz) have been mostly linked with patients experiencing chronic pain, such as people experiencing Fibromyalgia Syndrome. Power in the theta range from four EEG locations (Fz, C3, Cz and C4) showed that acupressure patients exhibited lower theta band EEG power, relative to before treatment. Reiki group did not how such relationship. The difference between during the treatment and after the treatment was not statistically significant.

Recruitment strategy changes: The initial proposal included Cleveland VA as a recruitment site. However, per Cleveland VA recommendation, the study recruited subjects only at Cleveland Clinic. Limited access to Veterans outside Cleveland VA slowed down the enrollment. Meanwhile, study subjects had to visit Cleveland Clinic two times per week for the intervention. This limited the number of subjects willing and being able to participate in the study. Different strategies have been used to enroll subjects for the study, such as online advertisement and mailing letter. The advertisement text (4 versions) was developed by Cleveland Clinic Marketing based on IRB approved study flier for this study. The online ads was placed on contextually relevant sites with content related to Gulf War veterans/ syndrome/ illness. Letters were also mailed to Gulf war veterans in order to improve the recruitment.

Changes on EEG/EMG setup: The original protocol required using to collect EEG data. The 64 channels were embedded in a skull cap and required injection of electrode gel (non-invasive) in each of the 64 electrode locations. The set-up took almost 30 minutes and the subjects sometimes got annoyed and uncomfortable. The clean-up process after completion of study recording were very inconvenient (required a hair wash) to subjects with a lot of hair, especially for females. While the 64-channel system is a very useful research tool, the EEG data collection arrangement deterred many eligible subjects. This 64 channel EEG system was used only on one subject, who withdrew from the study. We have acquired an 8 channel amplifier that can collect both EMG and EEG data. 3 channels of EMG data and 4 channels of EEG data from C3, C4, Cz and Fz locations. This allowed us to perform almost all of the proposed analysis and address the study aims. From a subject perspective, the EMG/EEG setup required only 15 minutes instead of the original 30-40 minutes. Post recording clean-up will be very fast as the electrode gel can be easily removed without need for hair wash.

3. Key Research Accomplishments

- Fatigue relief and pain alleviation was achieved in veterans with GWI treated with Acupressure along with the standard clinical care
- Acupressure patients exhibited lower theta band EEG power, relative to its baseline, while Reiki group did not show such relationship.
- EEG measures offer objective information helping identify symptomatic from healthy veterans and the severity of their GWI.

4. Conclusion

This project is to investigate the effectiveness of acupressure treatment in symptomatic relief for Gulf War Illness disease (GWI) and the abnormalities of central nervous system of symptomatic veterans by the objective electrophysiology measures. Acupressure is a kind of evidence based noninvasive treatment which has been practiced in Asian countries for a long time, with effectiveness in pain management, fatigue relief, and mobility improvement witnessed by numerous practitioners and patients. In this study, after the completion of the 6 weeks of acupressure treatment, positive finding can be observed in clinical outcomes, EMG, and EEG results. These positive findings may help establish acupressure treatment as an effective GWI intervention and develop more promising interventions that combine acupressure treatment with other physical programs. This results may also inform study design regarding other complex such as chronic fatigue syndrome, fibromyalgia, etc.

5. Publications, Abstracts, and Presentations

Nothing to report.

6. Inventions, Patents and Licenses

Nothing to report.

7. Reportable Outcomes

- Four subjects completed the study protocol (two subject for Acupressure and two for Reiki).
- Pain scale and fatigue scale decreased after 6-week Acupressure and Reiki treatments.
- EEG showed that acupressure patients exhibited lower theta band EEG power in comparison to baseline, while such relationship was not observed in Reiki group.
- This study indicates that continuing acupressure treatment, in addition to routine clinical care, has a positive effect on brain-to-muscle descending motor signal.
- This knowledge may lead to further refinement of the protocol as well as advancements in acupressure intervention for veterans with GWI.

8. Other Achievements

Nothing to report.

9. References

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10. Appendices

Nothing to report