Illinois Wesleyan University
Digital Commons @ IWU

John Wesley Powell Student Research Conference

2011, 22nd Annual JWP Conference

Apr 9th, 9:00 AM - 10:00 AM

Pulsed Radiofrequency Neuromodulation of Peripheral Nerve Injury

Alex Willett
Illinois Wesleyan University

Joseph Williams, Faculty Advisor
Illinois Wesleyan University

Follow this and additional works at: https://digitalcommons.iwu.edu/jwprc

 Part of the Psychology Commons

Willett, Alex and Williams, Faculty Advisor, Joseph, "Pulsed Radiofrequency Neuromodulation of Peripheral Nerve Injury" (2011). *John Wesley Powell Student Research Conference*. 25.
https://digitalcommons.iwu.edu/jwprc/2011/posters/25

This Event is protected by copyright and/or related rights. It has been brought to you by Digital Commons @ IWU with permission from the rights-holder(s). You are free to use this material in any way that is permitted by the copyright and related rights legislation that applies to your use. For other uses you need to obtain permission from the rights-holder(s) directly, unless additional rights are indicated by a Creative Commons license in the record and/ or on the work itself. This material has been accepted for inclusion by faculty at Illinois Wesleyan University. For more information, please contact digitalcommons@iwu.edu.
©Copyright is owned by the author of this document.

Pulsed Radiofrequency of Peripheral Nerve Injury

Alex Willett, Dana Tilley, Dr. Ricardo Vallejo & Dr. Joseph Williams

Illinois Wesleyan University

Abstract

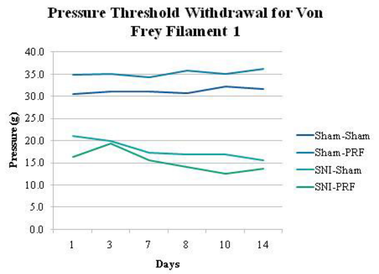
Pulsed-radiofrequency neuromodulation (PRF) is a pain management technique that involves placing a needle electrode near nerves and generating electrical current pulses in order to modulate the transduction of somatosensory information through those nerves. This technique evolved from a similar radiofrequency (RF) procedure in which constant current is distributed to a nerve or neural structure. RF interrupts nerve conduction and prevents somatosensory information from reaching the brain. In the case of continuous radiofrequency, however, the destructive lesion can cause further complications and unwanted side effects. According to research, PRF, unlike RF, is non-destructive yet still induces analgesia and consequently represents a more advantageous technique. Only a handful of previous studies have attempted to determine the neural effects of PRF. The current study seeks to develop an animal model of PRF using the spared nerve injury model and, through molecular analysis of neurological tissues harvested from rats, examines mechanisms by which PRF causes analgesia.

Hypothesis

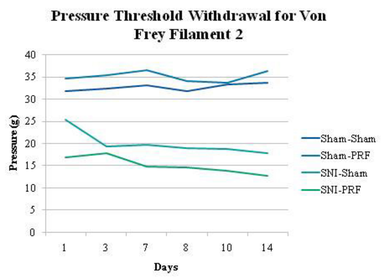
Rats receiving PRF stimulation will have a significant increase in hypersensitivity relief as compared to the group not receiving PRF stimulation.

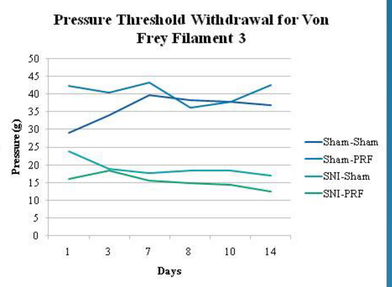
Procedure

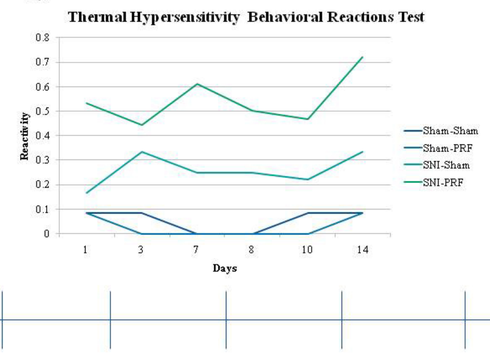
- Initial Surgery: This is considered day zero
- Use SNI lesion model to create a state of hypersensitivity by lesioning the tibial and common peroneal nerves, which are two of the three terminal branches of the sciatic nerve, but the third branch of the nerve, the sural nerve, is left intact.
- PRF stimulation occurred after behavioral testing on day 7
- The PRF probe was placed medial to the lesion and lateral to the spinal cord of the sciatic nerve.
- 45 volts were administered, and the temperature of the probe approached 42°C. However, it was not permitted to exceed that temperature because excessive heat would damage the neurons.
- The sciatic nerve, both left and right dorsal root ganglion and the spinal cord were harvested
- These tissues are located near the local site of the lesion and will be tested for the presence of cytokines.
- All of these cytokines are present in Neuropathic pain. (Cunha, Poole, Lorenzetti, and Ferreira, 1992)
  - Interleukin-1β
  - Interleukin-6
  - Tumor Necrosis Factor-α

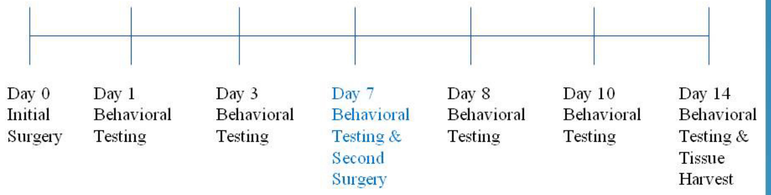


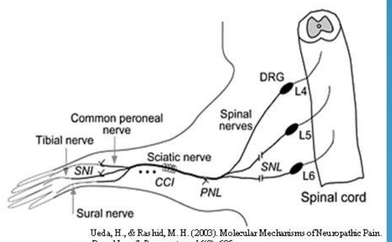
Sham-Sham 4 Rats	Sham-PRF 4 Rats
SNI-Sham 4 Rats	SNI-PRF 6 Rats











Ueda, H., & Rashid, M. H. (2003). Molecular Mechanisms of Neuropathic Pain. *Drug News & Perspectives, 16*(9), 605.

Acknowledgments: Dr. Jason Themanson, Dr. Linda Kunce, Leslie Wise & Ryan Willett

Results

Filaments: There was a significant difference between the Sham Group and the SNI model

Filament	Day of Testing	M (SD)	*t*	*p*
1	1	14.2 (10.4)	3.626	0.011**
1	3	12.7 (11.4)	3.164	0.016**
1	7	15.8 (10.3)	4.326	0.003**
2	1	11.8 (16.7)	1.873	0.110
2	3	13.7 (12.0)	3.224	0.015**
2	7	17.0 (10.6)	4.559	0.003**
3	1	12.4 (15.0)	2.198	0.070
3	3	16.7 (13.0)	3.648	0.008**
3	7	23.9 (10.7)	6.321	0.000**

Thermal Hypersensitivity: There was a significant difference between the Sham Group and the SNI model

Day of Testing	M (SD)	*t*	*p*
1	-0.190 (0.262)	-1.922	0.103
3	-0.333 (0.252)	3.742	0.007**
7	-0.417 (0.295)	-3.989	0.005**

Filaments: PRF produced no significant hypersensitivity relief compared to the controls

Filament	Day of Testing	Effect	*F*	*p*
1	1	Treatment	1.486	0.245
1	1	Treatment*Group	0.894	0.470
1	3	Treatment	2.126	0.170
1	3	Treatment*Group	1.454	0.276
1	7	Treatment	0.024	0.880
1	7	Treatment*Group	0.829	0.500
2	1	Treatment	2.461	0.141
2	1	Treatment*Group	0.753	0.540
2	3	Treatment	0.667	0.430
2	3	Treatment*Group	0.447	0.724
2	7	Treatment	0.458	0.510
2	7	Treatment*Group	0.252	0.859
3	1	Treatment	1.061	0.322
3	1	Treatment*Group	3.722	0.039**
3	3	Treatment	0.300	0.594
3	3	Treatment*Group	0.922	0.460
3	7	Treatment	1.807	0.200
3	7	Treatment*Group	0.252	0.859

Thermal Hypersensitivity: PRF produced no significant hypersensitivity relief compared to the controls

Day of Testing	Effect	*F*	*p*
1	Treatment	0.005	0.946
1	Treatment*Group	0.584	0.636
3	Treatment	0.028	0.871
3	Treatment*Group	0.286	0.835
7	Treatment	2.364	0.146
7	Treatment*Group	0.017	0.997

** = p value is significant

Discussion

Limitations

- Peak concentrations of the cytokines occur seven days after the onset of injury, it is possible that the 14-day span of data collection could have interfered with the analgesic effects of the PRF stimulation.
- Relatively small sample size, yet this is unlikely because the data was collected by two different people (both were blind to which rats had received the SNI model and PRF stimulation), and each set of collections had data that was consistent. Also, there were significant differences between the Sham group versus the SNI model group.
- Also, the placement of the electrodes on the sciatic nerve and the impedance of the tissue (the resistance of the tissues the current passes through) could have affected the results.

Future Research

- Shorten the data collection of each rat to a total time frame of 7 days and the PRF stimulation would be administered in the middle of the week. This time frame may produce significant results because the cytokines would be at their peak levels by the end of the 7 days after the lesion was induced.
- Determine whether it is the chemical components in the neurons or the electrical activity that produces the analgesic effects of PRF stimulation using lidocaine.

Conclusion

Pulsed radiofrequency neuromodulation is a surgical technique that is used to produce analgesic effects in individuals suffering from chronic neuropathic pain. This technique does not destroy neurons which eliminates many of the aversive side-effects that RF would normally produce. However, it now appears that, at least in rats, PRF is not the ideal procedure for lesions that resemble SNI models of hypersensitivity. The present study adds to the current literature of PRF stimulation and opens the doors to further surgical explorations in future research.