Impact of RNS Volume Conduction at the Seizure Onset Zone

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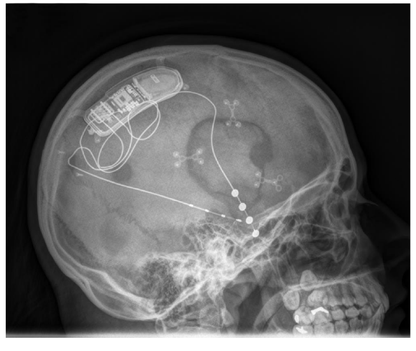
Introduction

- Responsive neurostimulation (RNS) is an FDA approved intervention for epilepsy patients who are medication resistant and are poor candidates for surgical removal of brain tissue
- RNS treatment involves the implant of two electrode leads that continuously monitor neural activity and stimulate when a seizure is detected
- While many patients have a significant reduction in seizure frequency, optimization of RNS therapy is difficult because the mechanism of action is currently unknown
- The objective of this study is to implement a patient-specific volume conduction model to determine the impact of RNS stimulation settings on the seizure onset zone (SOZ)

Methods

- 6 patients with epilepsy undergoing RNS therapy were studied
- A whole brain distributed dipole model was generated for each patient from their reconstructed preoperative MRI scan using Brainstorm
- The electrical potential induced at the SOZ by stimulation was calculated, considering the RNS lead configuration and stimulation intensity



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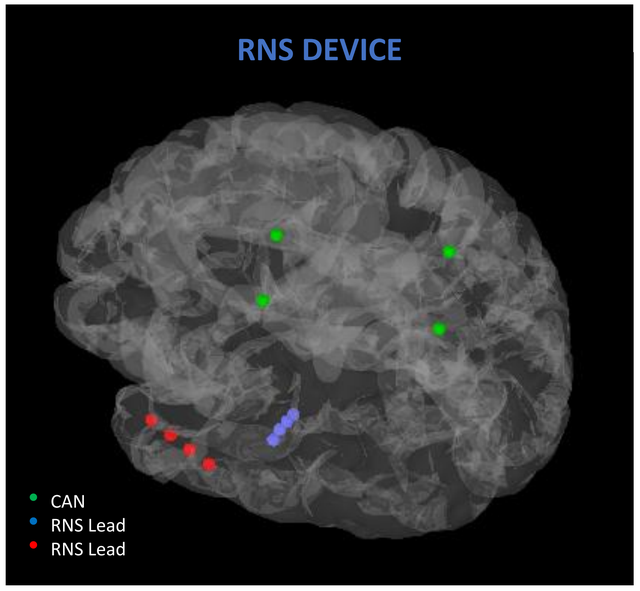

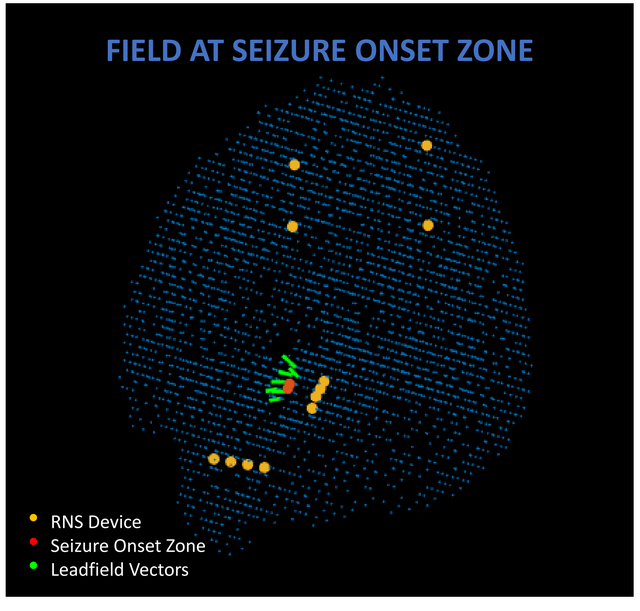

Results

- We found that the proximity of RNS electrode leads to the SOZ did not have a significant association with a patient's seizure reduction (both patient reported and device recorded)
- The results suggest that the short-term impact of stimulation at the SOZ may not be a primary factor contributing to seizure reduction in RNS patients and that surgical planning of RNS lead targets shouldn't be constrained by the SOZ site
- Our results are corroborated by the theory that epilepsy is a network disorder and the RNS device serves to modulate the network by strengthening inhibitory connections
- Prior work suggests it is more important to locate RNS leads near particular brain structures rather than the SOZ

Conclusions

- In this proof-of-concept study, we have developed a method for simulating patient-specific RNS lead activation parameters
- Future work includes using our methods to uncover alternative anatomical implant target locations that better correspond with seizure reduction outcomes

References

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