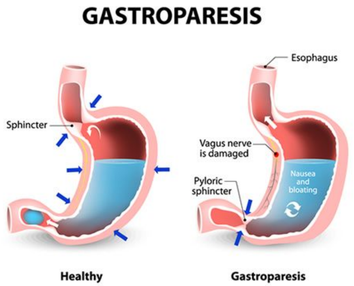
Inducing Artificial Gastric Peristalsis in Mouse Models

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Background

Gastroparesis is a chronic and debilitating gastrointestinal disorder characterized by delayed gastric emptying in the absence of mechanical obstruction.



- Prevalence: 1.8%
- Symptoms: nausea, vomiting, abdominal pain, bloating, early satiety and weight loss.

There is a significant unmet clinical need for more effective, safe, and well-tolerated treatments for gastroparesis.

- Goal is to manage symptoms, improve gastric emptying, and enhance patient quality of life.
- Solution that is scalable and cost-effective, widely accessible to all patients suffering from gastroparesis.

Methods

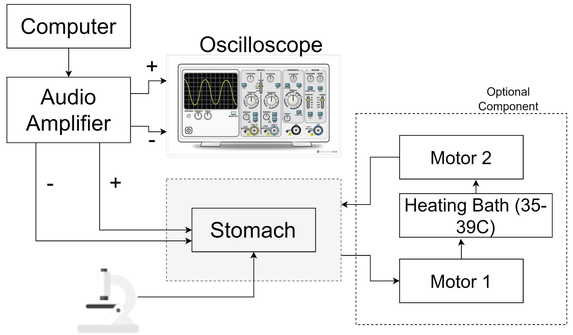
Device:

- Materials: carbon fiber and activated carbon powder.
- Preparation: ratios of 5:100, 5:50, 5:40, 5:30, 5:20 and 5:10 of active materials with a 1:1 mixture of Ecoflex 00-30 platinum cure silicone rubber. 3D printed molds for device.

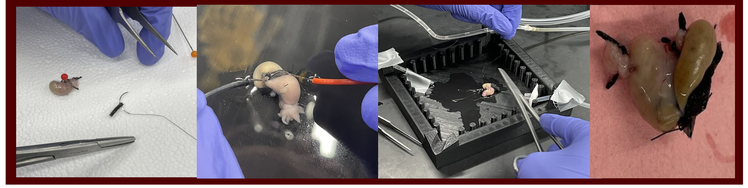
Stimulation:

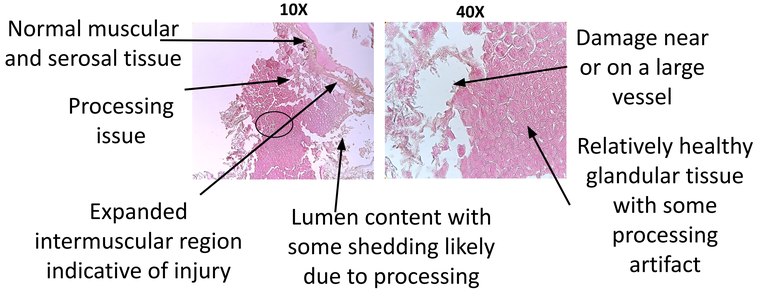
- Murine gastric models were harvested within 1 hour of death.
- Device sutured along the length of the stomach.
- PBS or Krebs solution used for testing.
- Device stimulated using a function generator.

Prototypes and Testing



- A single device band was surgically sutured onto the mouse stomach, providing stability.
- Stimulation was applied using an audio amplifier, allowing controlled electrical impulses to be delivered to the stomach.
- This setup facilitated precise monitoring and analysis of the effects of the stimulation on the mouse stomach.





Results

- Square wave stimulation at 1 Hz and 0.5 Hz frequencies produced rapid esophageal contractions, with increasing voltage leading to heightened amplitudes.
- Signs of damage on the serosal surface that were clear.
- Injuries near what appear to be a large vessel that degraded, perhaps due to autodigestion near a puncture.

Conclusion

While esophageal contractions were visible, there was limited movement of the fundus even until the point of tissue damage. This damage was due to high voltage burn injury. With such a large surface area and muscle density, a dual stimulator of muscle contraction may not be enough to propagate motion over the entire stomach.

Discussion/ Future

More testing is required for stimulation treatment with different material composites. Further testing is also needed for larger stomachs to see the difference in electricity needed to provide the same stimulation.

References & Acknowledgements

1. Saleem S, Inayat F, Aziz M, Then EO, Zafar Y, Gaduputi V. In-hospital mortality in gastroparesis population and its predictors: A United States-based population study. *JGH Open*. 2021;5(3):350-355. doi:10.1002/jgh3.12500
2. Ingestible transiently anchoring electronics for microstimulation and conductive signaling | Science Advances. Accessed March 2, 2024. https://www.science.org/doi/full/10.1126/sciadv.aaz0127
3. Pathophysiology, Aetiology and Treatment of Gastroparesis | Digestive Diseases and Sciences. Accessed March 2, 2024. https://link.springer.com/article/10.1007/s10620-020-06287-2.
4. Physiology, Peristalsis - StatPearls - NCBI Bookshelf. Accessed March 2, 2024. https://www.ncbi.nlm.nih.gov/books/NBK556137/
5. The gastric conduction system in health and disease: a translational review | American Journal of Physiology-Gastrointestinal and Liver Physiology. Accessed March 2, 2024. https://journals.physiology.org/doi/full/10.1152/ajpgi.00065.2021
6. Huang I, Schol J, Khatun R, et al. Worldwide prevalence and burden of gastroparesis-like symptoms as defined by the United European Gastroenterology (UEG) and European Society for Neurogastroenterology and Motility (ESNM) consensus on gastroparesis. *United European Gastroenterol J*. 2022;10(8):888-897. doi:10.1002/ueg2.12289

We would like to thank our faculty and advisors at Texas A&M - EnMed, the resources and expertise of the EnMed Innovation Center (EIC).