Gastroesophageal Resuscitative Occlusion Of The Aorta: An Emerging Device That Could Aid In Control Of Non-Compressible Truncal Hemorrhage Near The Point Of Injury

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Background

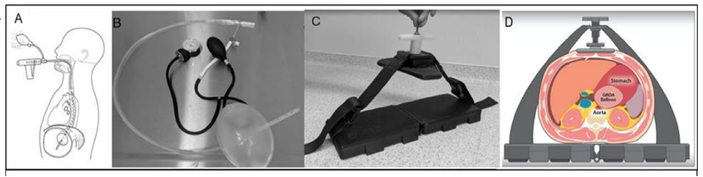
- Non-compressible truncal hemorrhage (NCTH) remains a leading cause of preventable death in trauma.
- Despite continued developments and employment of Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA), truncal injuries continue to carry a high mortality risk, especially in pre-hospital settings.
- The arterial cannulation required for REBOA placement can be time consuming and requires an advanced skill set and equipment that is rarely available in pre-hospital settings.

Objective

- Utilize a perfused cadaver model to evaluate the effectiveness of a prototype Gastroesophageal Resuscitative Occlusion of the Aorta (GROA) device which was developed to fill the gap in pre-hospital tools for control of NCTH.

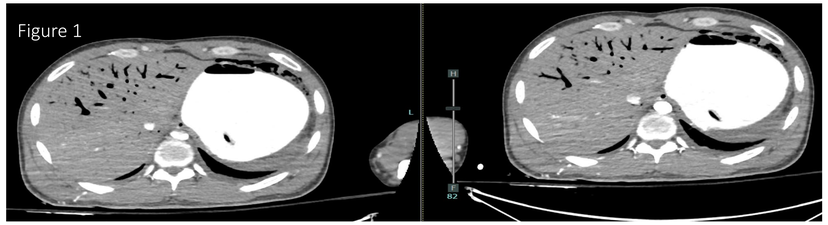
Methods

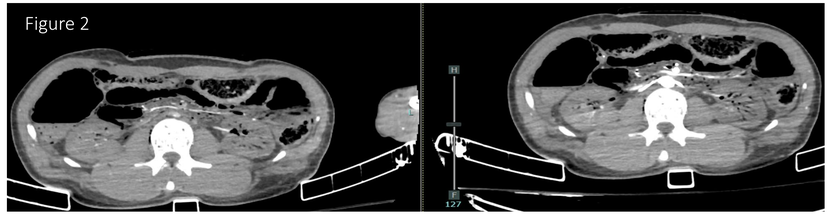
- Placement of the GROA device was attempted in 7 perfused cadavers over a 2-day period.
- Ultimately, successful placement occurred in 4 of 7 cadavers via neck cut down and passage of the device directly into the esophagus via an esophageal incision.
- The external compression component was then applied and the GROA balloon inflated incrementally.
- CT images were obtained with the GROA system in various stages of inflation and compression while the cadaver was being perfused to monitor the degree of aortic occlusion.



Results

- In 3 of 4 cadavers with successful placement into the stomach, CT images demonstrated compression of the aorta and/or cessation of arterial contrast flow distal to the balloon at the level of the celiac trunk.
- The 4th successfully placed device failed to achieve aortic compression despite repositioning due to deviation of the balloon to the left upper quadrant into the redundant fundus of that cadaver.
- Device placement was unsuccessful due to poor tissue compliance in 2 cadavers and a history of advanced esophageal cancer in a 3rd.





Figures 1 and 2: Sample CT image at the level of the stomach (above) and renal arteries (below) with inflated GROA device in place
Left image: inflated balloon with external compression.
Right image: inflated balloon without external compression.

Figure 3 (Left): example of the GROA system including the balloon component (panel B) and the external compression device (panel C).

Discussion

- The GROA device takes advantage of the anatomic relationship between the proximal stomach, descending aorta and the thoracic vertebra to occlude the aorta via focused external compression of a balloon device in the proximal stomach.
- Tiba et al. proved physiologic feasibility of GROA in swine models.
- The devices used were prototype devices intended to demonstrate feasibility in human anatomy while providing feedback for device refinement.

Conclusions

- This proof-of-concept study in a perfused cadaver model has demonstrated the initial feasibility of the GROA device.
- Areas for design improvement include changes to the balloon shape and size, changes to the tubing and inflation mechanism and inclusion of a mechanism to secure the balloon at the GE junction.
- With further research and device refinement, GROA may prove a viable method for efficient, effective, and widely available temporary control of NCTH until definitive surgical intervention can be achieved.

References and Acknowledgements

- Tiba MH, McCracken BM, Colmenero CI, Plott JS, Leander DC, Greer NL, Wang SC, Shih AJ, Eliason JL, Ward KR. Gastroesophageal resuscitative occlusion of the aorta: Physiologic tolerance in a swine model of hemorrhagic shock. J Trauma Acute Care Surg. 2020 Dec;89(6):1114-1123. doi: 10.1097/TA.0000000000002867. PMID: 33112534.

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