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Article
Resuscitative endovascular balloon occlusion of the aorta (REBOA) for major abdominal venous injury in a porcine hemorrhage shock model
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Clinical Question
How does REBOA affect hemodynamics, blood loss, and survival in an animal (porcine) model?

Study Type
Randomized Controlled Therapeutic Study

Methods
10 pigs were split into a test/REBOA arm or into a control arm for a total of 5 each. All pigs then had a carotid, jugular, and IVC catheters placed after being placed on general anesthesia. In order to simulate acidosis and shock physiology, all pigs had 35% of their blood volume removed followed by having their aorta cross-clamped for 45 minutes just proximal to the celiac artery. After releasing the clamp, all pigs were placed on an epinephrine drip to maintain MAP >40 mmHg. This was then followed by 4 hours of "resuscitation" with IVF and pressors. All pigs had the right common iliac vein opened just distal to the IVC bifurcation. Control arm pigs were monitored without any further fluids or pressors. The therapeutic arm pigs had REBOA placed but uninflated *prior* to the iliac vein incision; 60 seconds after free bleeding from the iliac vein, the REBOA balloon was inflated. Pigs were monitored until sustained MAP of < 20 mm Hg or for 45 minutes, then euthanized.

Results
All 10 animals were able to be followed to the preset endpoints. The 5 animals in the control group had a much shorter survival time, average of 4.1 minutes vs 40.1 minutes in the REBOA group. The therapeutic group also had significant improvement in the MAP from the 50s to the 90s mm Hg after REBOA was initiated. While both groups lost an equal amount of blood the rate of blood loss was 14 times faster in the control group. Finally, wedge pressures and CVP were followed in both groups and found to not change significantly between the REBOA group and the control group

Study Limitations/Issues
The clear limitation of this study is the model: pigs. The authors had to try to modify the injuries and physiology to imitate the human body and its response to major injury. Furthermore, these models were sedated, on a vent, and then injured, which clearly is not how traumatic injuries occur. Additionally, the REBOA device was in place and only needed to be inflated; clearly this would be much different in the trauma bay for a patient arriving 15 minutes after an injury and trying to get this device placed and inflated as rapidly as possible.

Discussion
The REBOA device appears to be a promising temporizing measure for a patient with rapid venous hemorrhage. While anesthetized pigs are not the perfect model, demonstrating that the rate of hemorrhage can be significantly decreased using REBOA is encouraging. If this did have similar results in humans, the ability of an ED physician to rapidly stop hemorrhage to give a patient an extra half hour to be transported from a scene or to a trauma center would be impressive. Based on this article, I think that use of REBOA for patients that require emergent surgery that will be delayed is probably appropriate.

Although human data is still being collected, there is some evidence that shows this may help, so for a patient in extremis, using this therapy may be lifesaving and worth a try.