

# *Resuscitative Endovascular Balloon Occlusion of the Aorta*

Placenta Accreta Spectrum Workshop

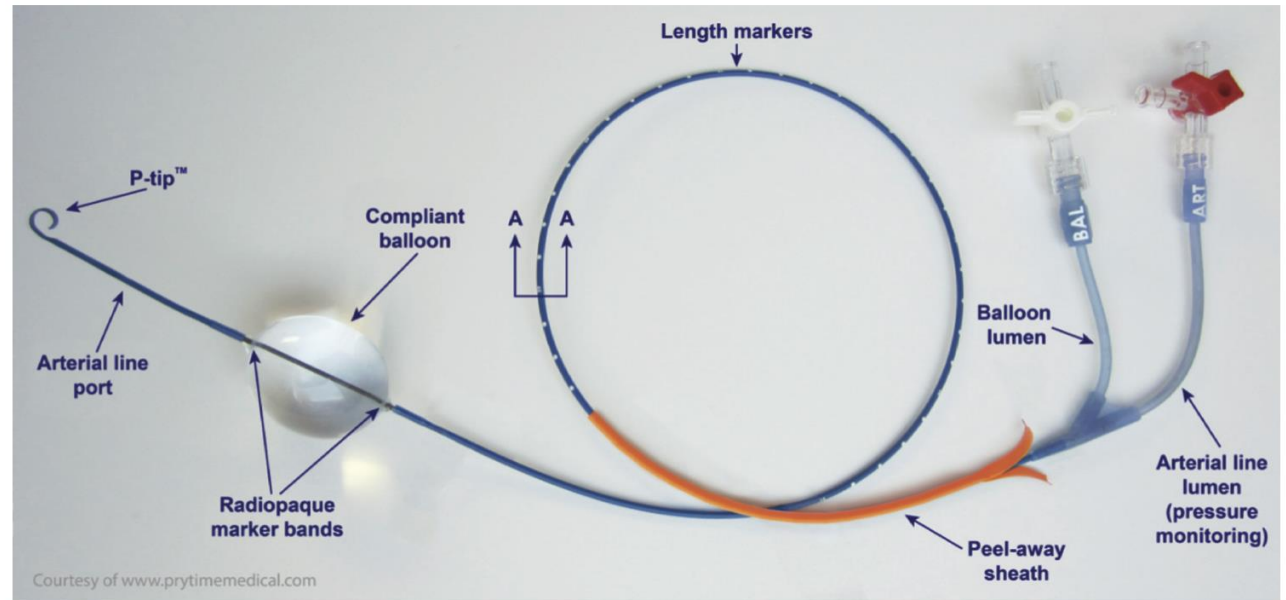
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**Corey Detlefs, MD, FACS**  
**Clinical Professor of Surgery**  
**Trauma, General and Acute Care Surgeon BUMCP**  
**Founding Member BUMCP Accreta Program**  
**Retired**

**No Disclosures**

# *Objectives: Resuscitative Endovascular Balloon Occlusion of the Aorta*

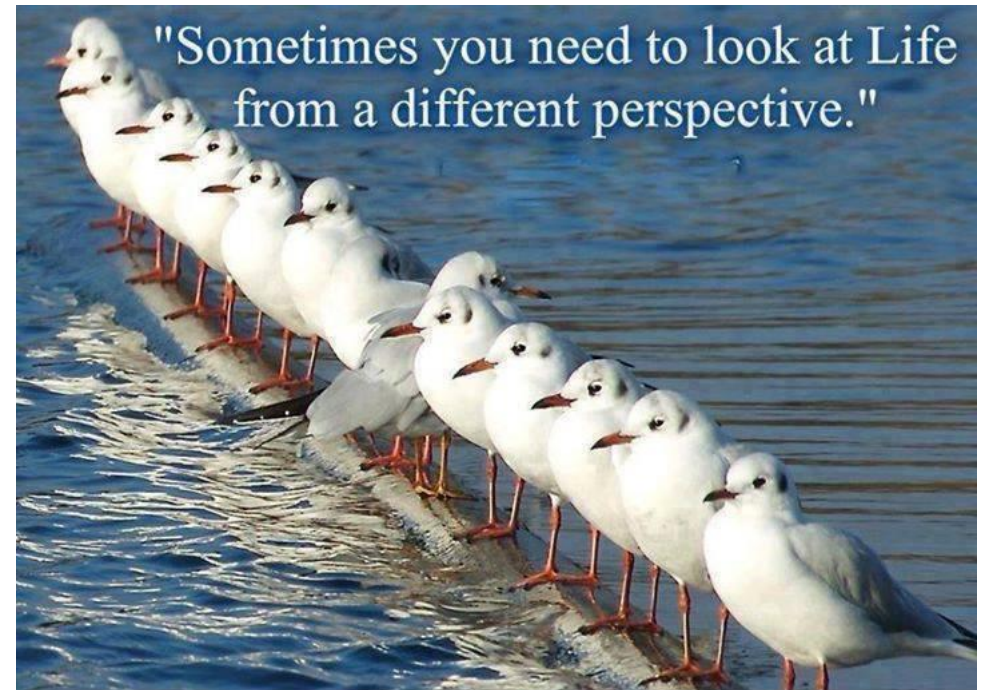
- What is it?
- Review concepts of hemorrhage control
- REBOA technique
- REBOA: pertinent questions in PAS surgery



**Figure 2.** An example of an ER-REBOA catheter and balloon. Image courtesy of Prytime Medical, Inc., [www.prytimemedical.com](http://www.prytimemedical.com).

# *Hemorrhage Control: Trauma Perspective*

- Recognize!!
- Isolate the injured organ
- Direct compression, topical adjuncts
- Establish proximal and distal vascular control
- Repair/remove organ while resuscitating
- Restore perfusion

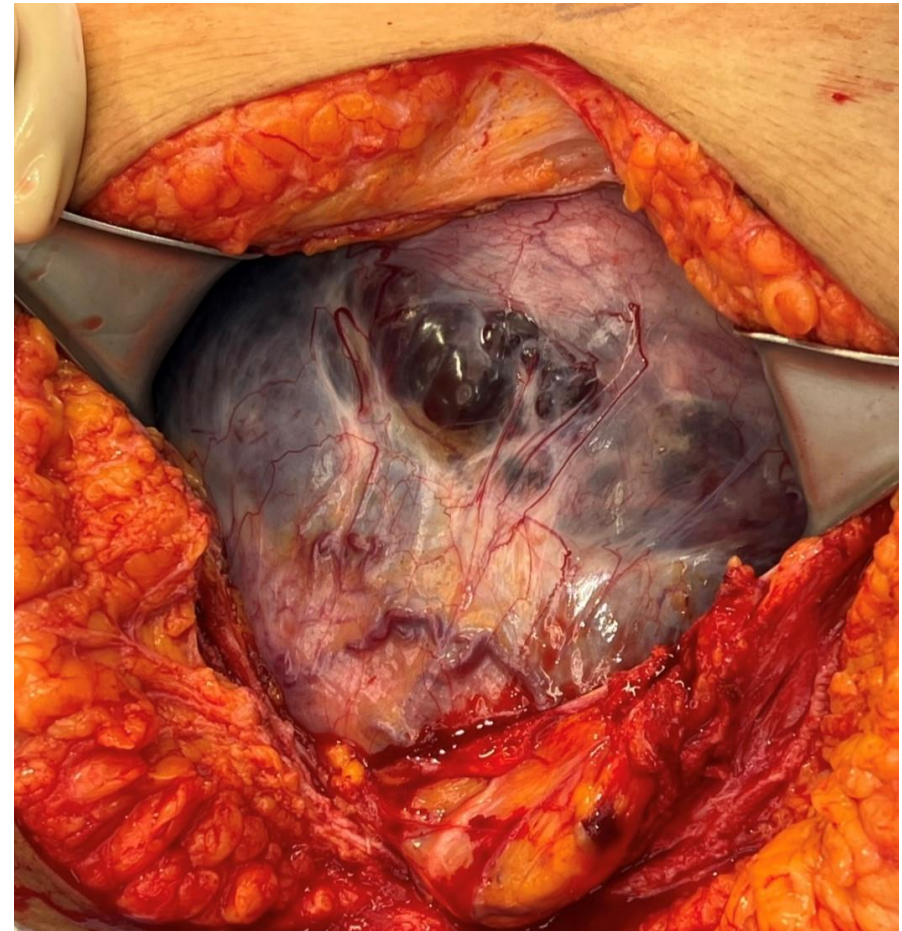
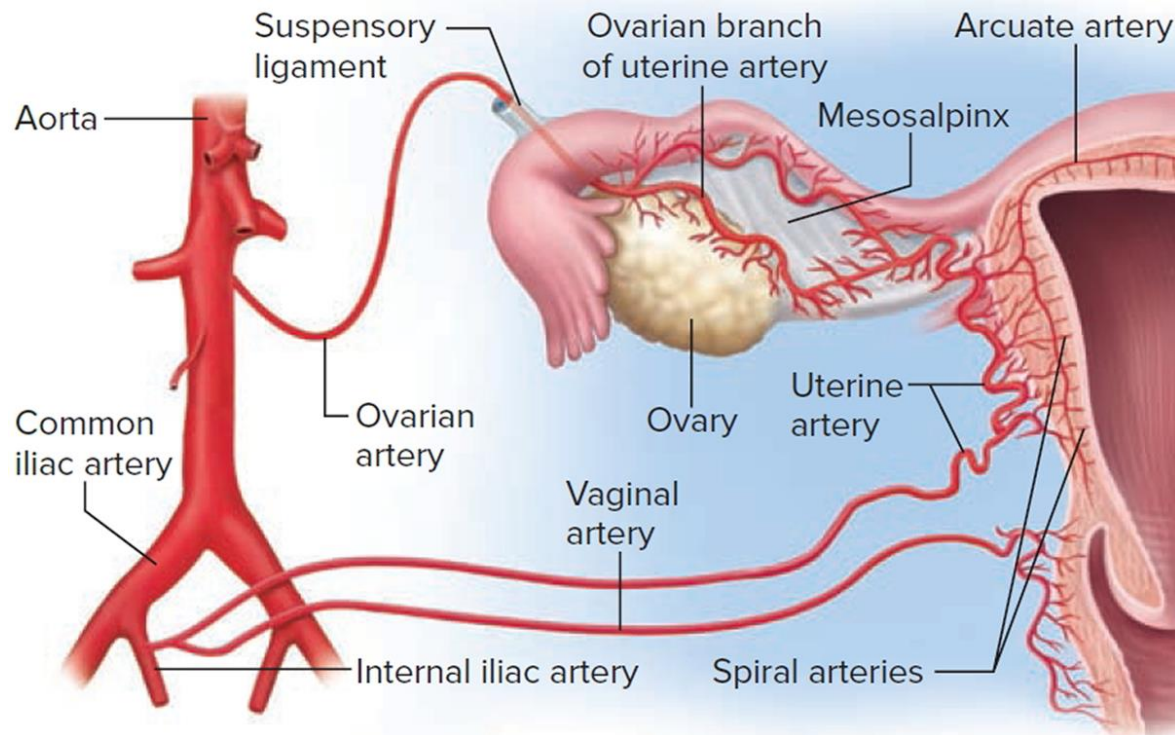


# *Proximal and Distal Control*

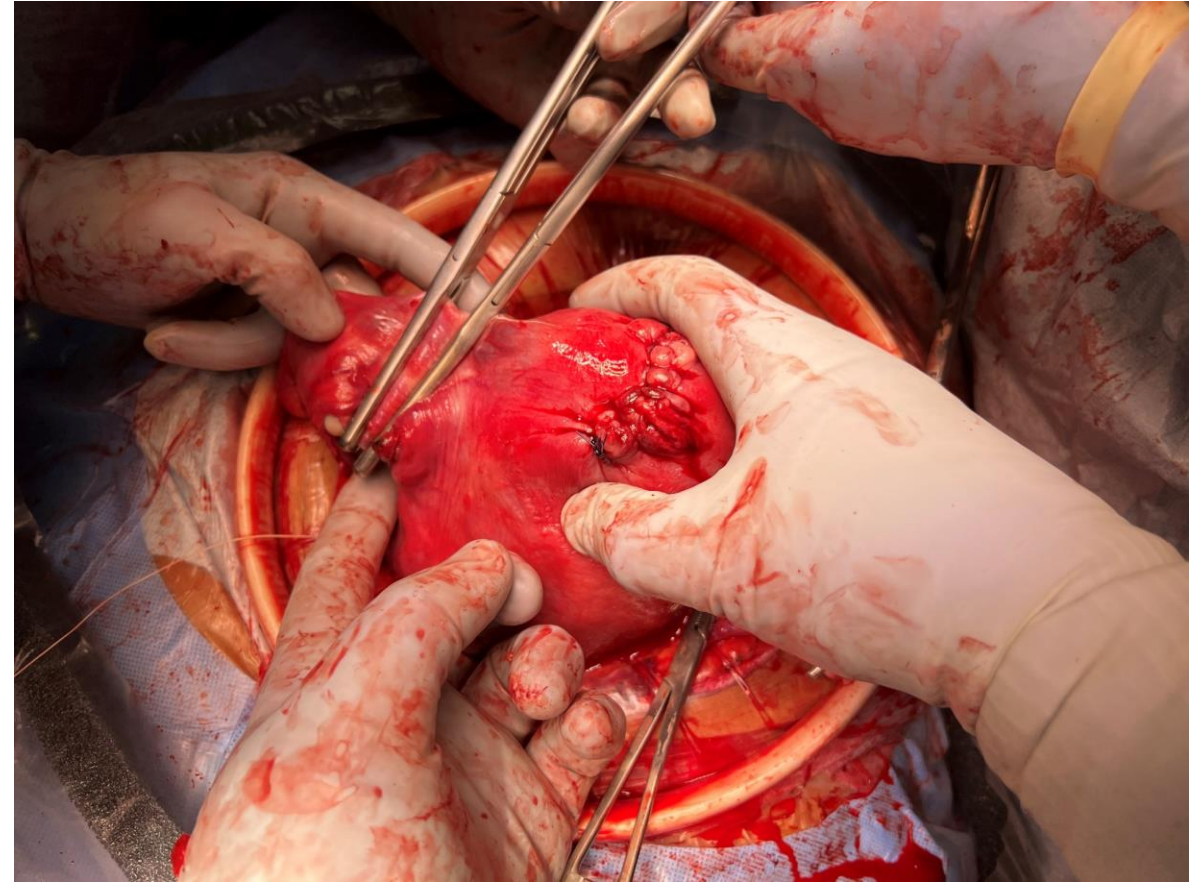
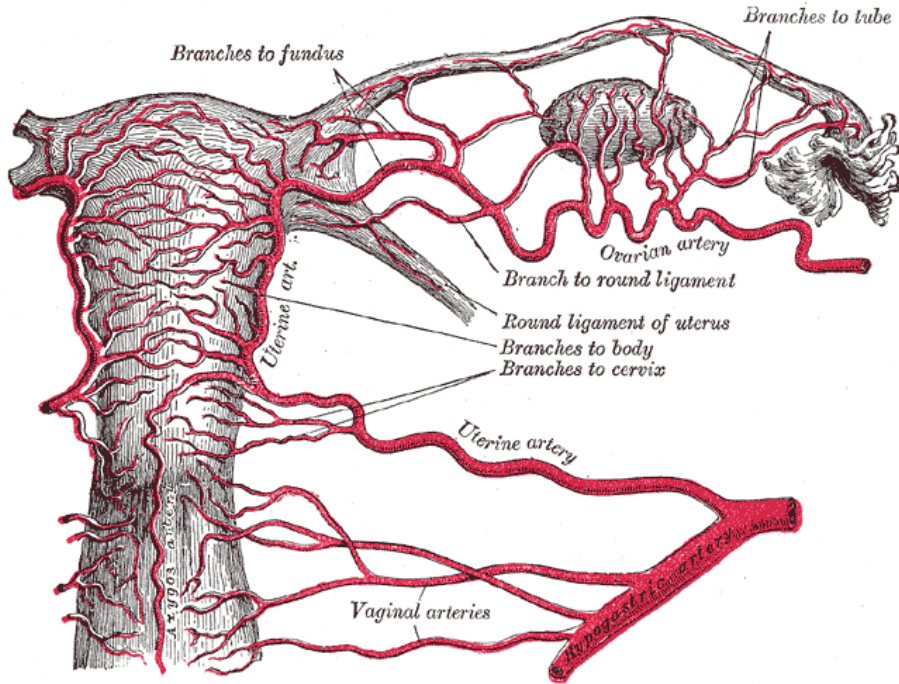


- Control arterial inflow
- Control venous outflow
- Sometimes arterial inflow control alone

# *PAS: Uterine Artery Anatomy Varies*

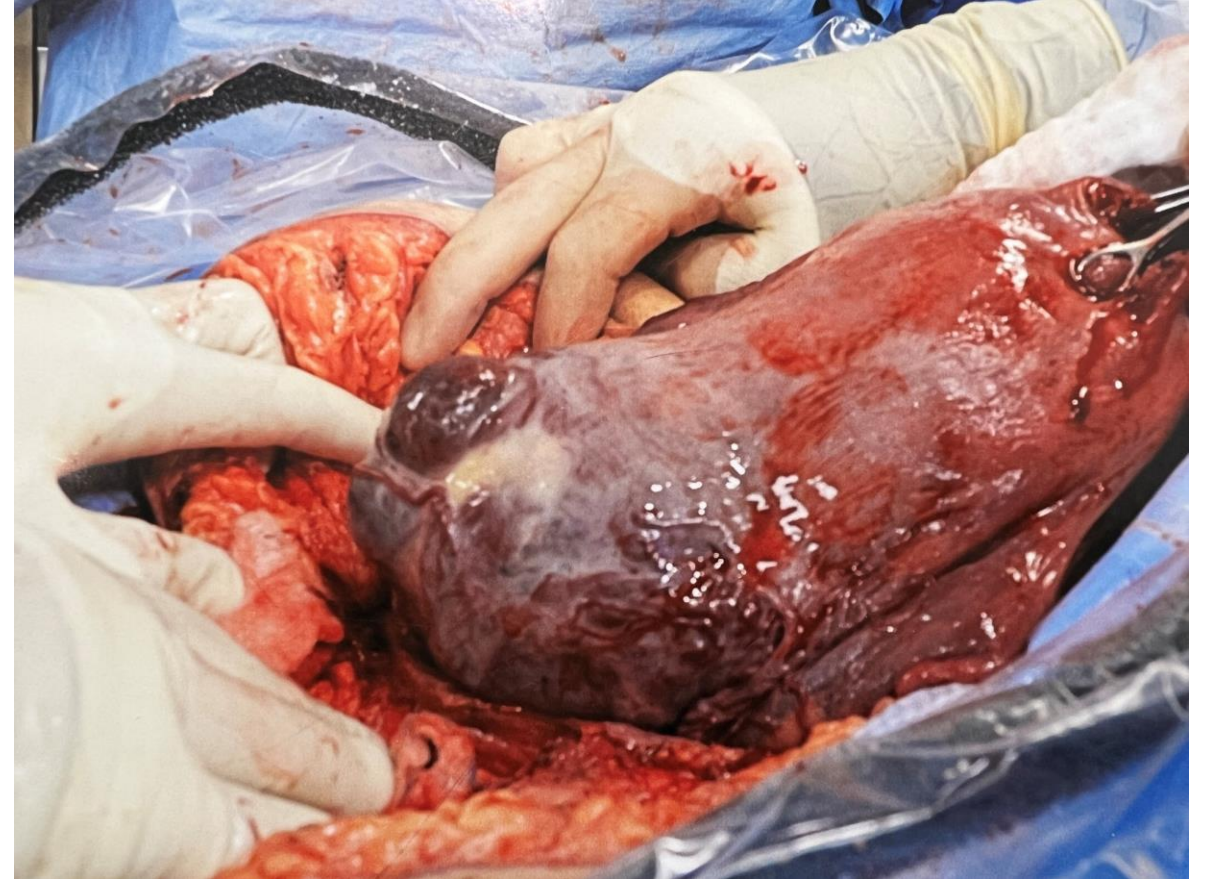


# Utero-ovarian Arterial Control



# *Uterine Artery Control*

- Now how do you control uterine arteries?? Especially with percreta?
- Embolization by IR
- Balloon occlusion of internal iliac arteries?
- Aortic balloon occlusion: REBOA



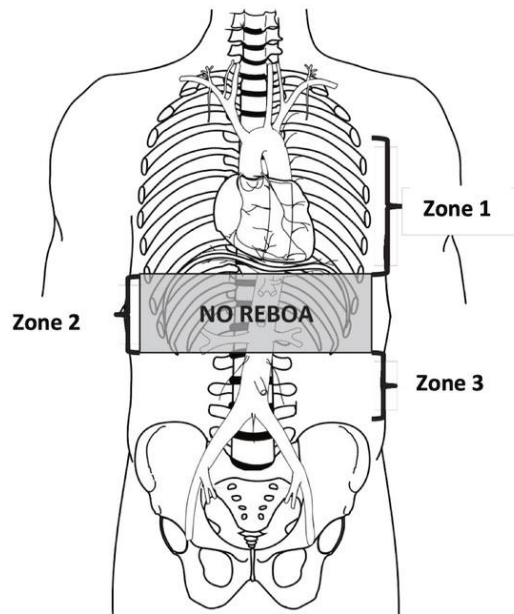
# Aortic Control of Uterine Arteries

## REBOA

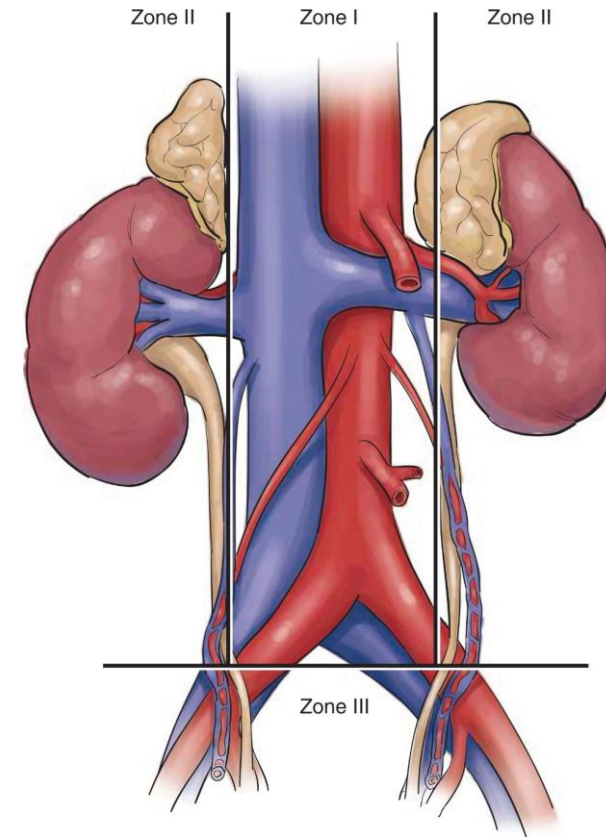
Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) for Hemorrhagic Shock

CPG ID: 38

### APPENDIX C: AORTIC ZONES



## Direct aortic compression





# WHAT IS REBOA CATHETER?

## ER-REBOA Catheter 6 French

Abdominal aorta with REBOA balloon deployed in the distal portion of aortic zone 3.

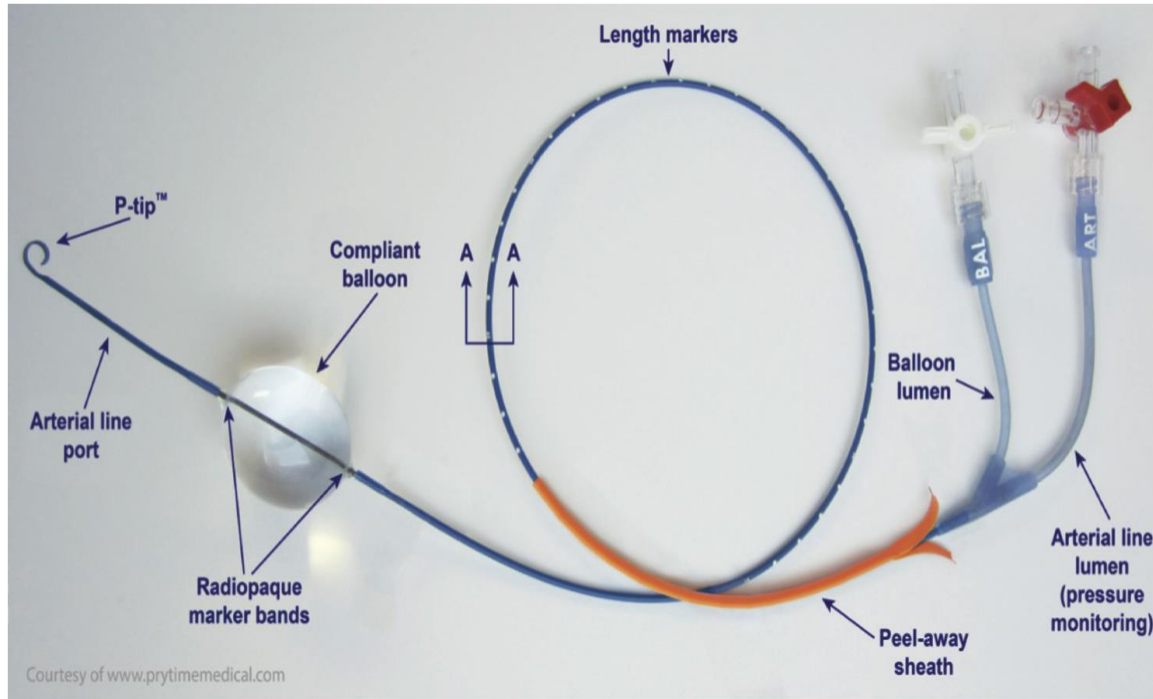
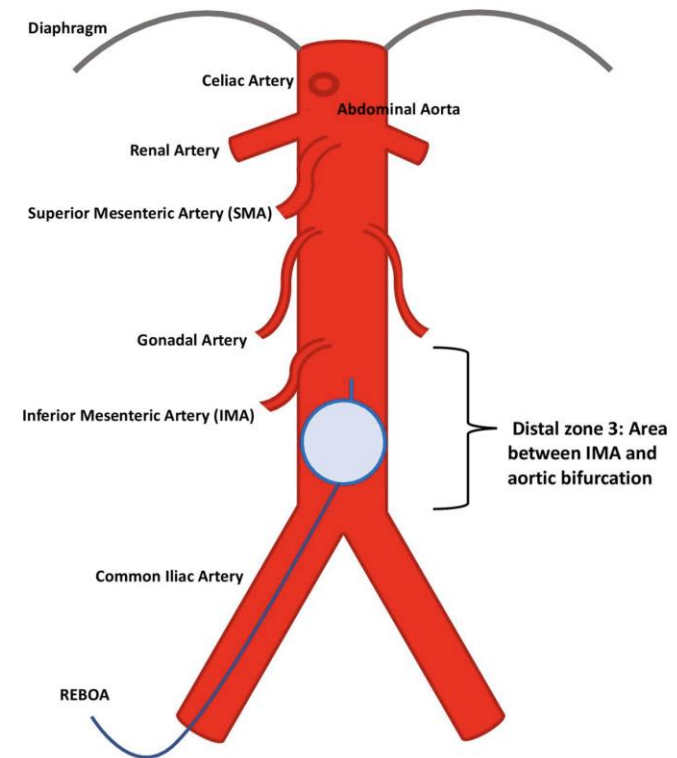
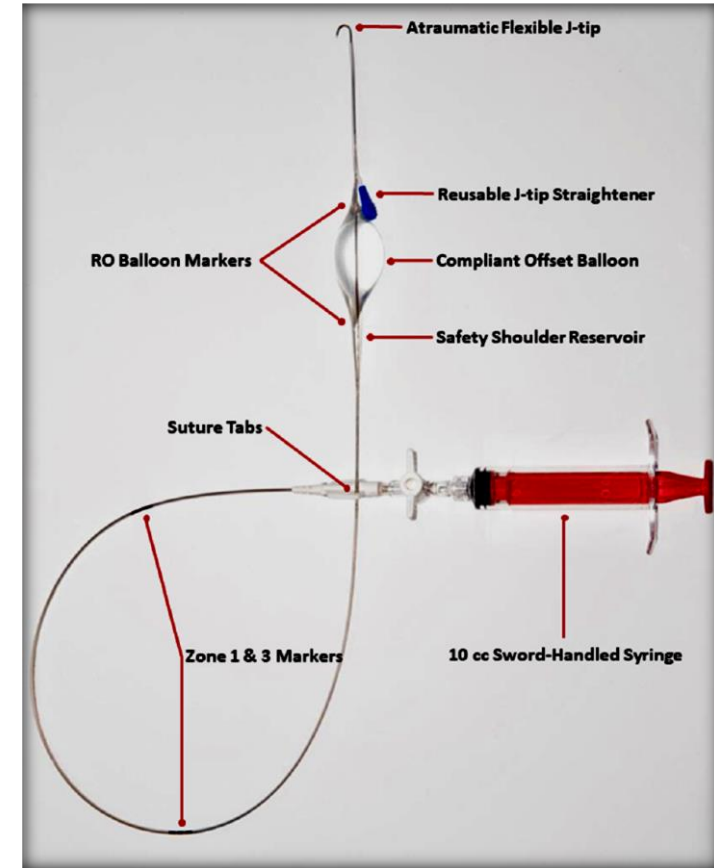
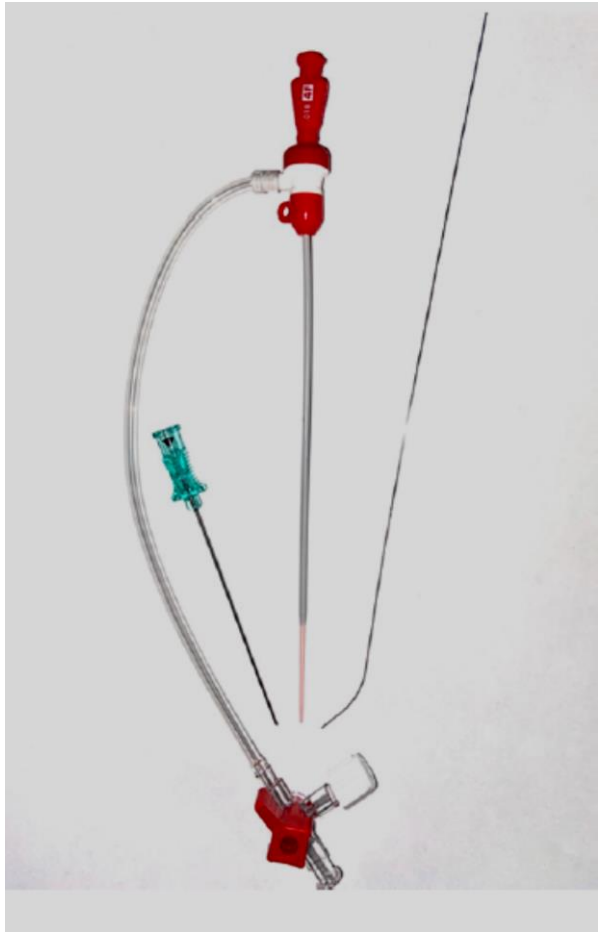


Figure 2. An example of an ER-REBOA catheter and balloon.



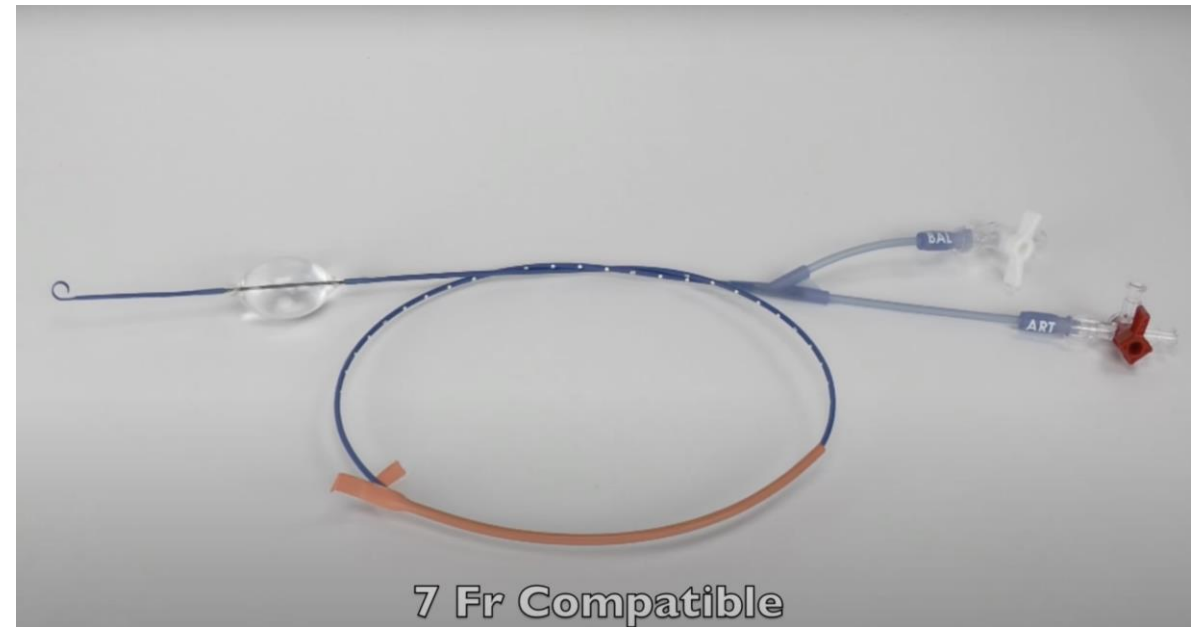
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# COBRA-OS (4 French Catheter)



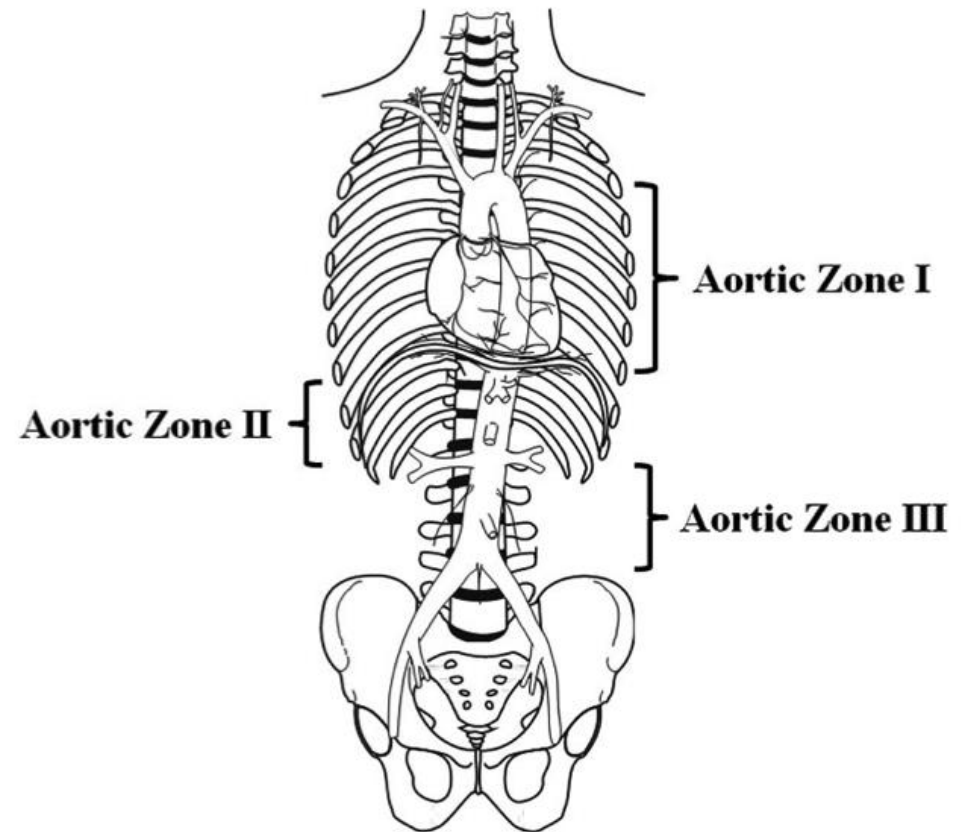
# *REBOA Catheter Preparation*

- RN familiarity/support essential!!
- Evacuate balloon
- Cover balloon and end with peel away sheath
- Attach arterial line transducer, flush



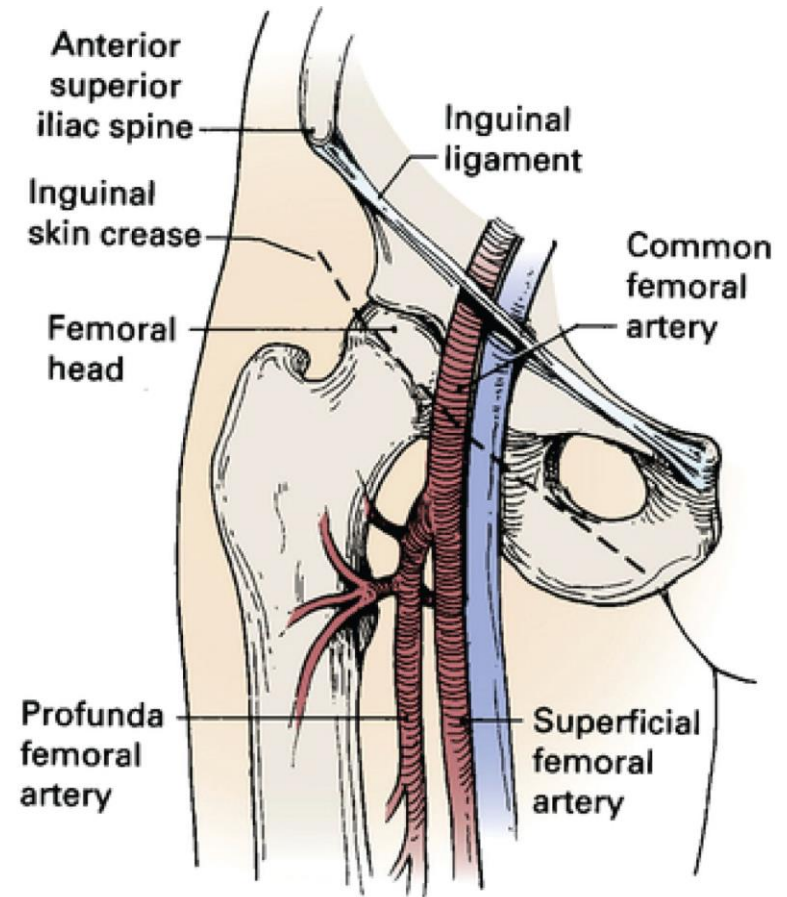
# *REBOA: STEPS*

1. Arterial access: supine
2. Balloon positioning
3. Balloon inflation and securing
4. Definitive control bleeding
5. Balloon deflation
6. Sheath removal



# *COMMON Femoral Artery Access*

- Just caudal to inguinal ligament
- Avoid superficial femoral artery puncture
- Micro puncture access
- Upsize to 4-7 French sheath

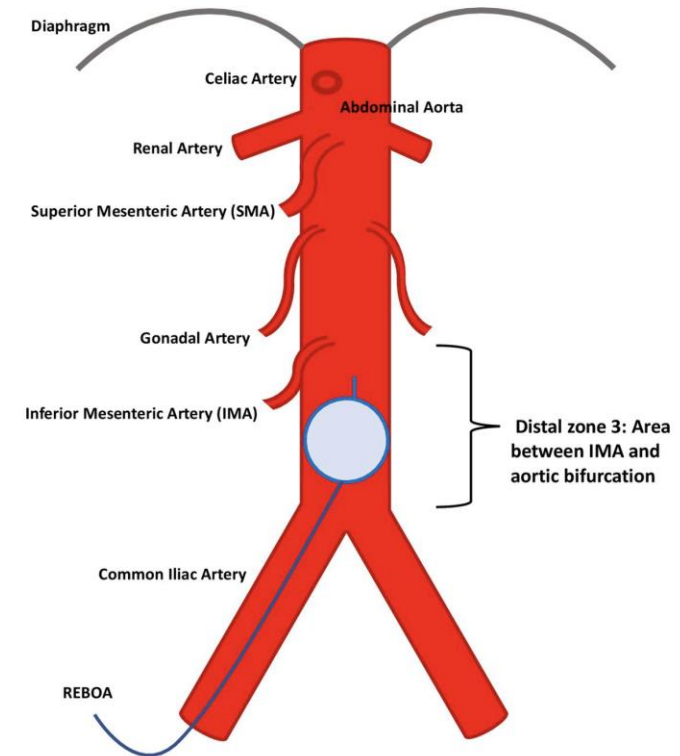


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# Balloon Positioning for Uterine Bleeding Control

- Zone 3 target
- Measure from insertion site to xiphoid
- Below renal arteries
- Confirm balloon position
- Secure catheter: **BALLOON CAN MIGRATE**

Abdominal aorta with REBOA balloon deployed in the distal portion of aortic zone 3.



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# *REBOA Complications: Three Types*

- Femoral arterial access
- Balloon positioning and inflation
- Reperfusion: metabolic, cardiovascular

# *REBOA in PAS Surgery*

- Patient selection: All? Percreta? Lower uterine segment?
- Balloon location: Zone 1 vs 3?
- Timing for placement and occlusion:
  - Femoral access early, upsize sheath if needed? (Supine)
  - Inflate after Cesarean? Only if bleeding?
  - Total occlusion time <30-60 minutes: reperfusion risk
- Partial REBOA? Periodic deflation?



# *REBOA in PAS: Take Away Pearls*

- Familiarity essential
- May help in PAS surgery
- Postpartum Hemorrhage
- Occlusion time = ischemia



# References 1

- Brenner, M. (2024). The Role of Resuscitative Endovascular Balloon Occlusion of the Aorta. In *Surgical Clinics of North America* (Vol. 104, Issue 2, pp. 311–323). W.B. Saunders. <https://doi.org/10.1016/j.suc.2024.01.003>
- Collins, S. L., Alemdar, B., van Beekhuizen, H. J., Bertholdt, C., Braun, T., Calda, P., Delorme, P., Duvokot, J. J., Gronbeck, L., Kayem, G., Langhoff-Roos, J., Marcellin, L., Martinelli, P., Morel, O., Mhallem, M., Morlando, M., Noergaard, L. N., Nonnenmacher, A., Pateisky, P., ... Chantraine, F. (2019). Evidence-based guidelines for the management of abnormally invasive placenta: recommendations from the International Society for Abnormally Invasive Placenta. *American Journal of Obstetrics and Gynecology*, 220(6), 511–526. <https://doi.org/10.1016/j.ajog.2019.02.054>
- du Bose, J. J., Scalea, T. M., Brenner, M., Skiada, D., Inaba, K., Cannon, J., Moore, L., Holcomb, J., Turay, D., Arbabi, C. N., Kirkpatrick, A., Xiao, J., Skarupa, D., & Poulin, N. (2016). The AAST prospective Aortic Occlusion for Resuscitation in Trauma and Acute Care Surgery (AORTA) registry: Data on contemporary utilization and outcomes of aortic occlusion and resuscitative balloon occlusion of the aorta (REBOA). *Journal of Trauma and Acute Care Surgery*, 81(3), 409–419. <https://doi.org/10.1097/TA.0000000000001079>
- Jacob Glaser, C. (n.d.). *Guideline Only/Not a Substitute for Clinical Judgment JOINT TRAUMA SYSTEM CLINICAL PRACTICE GUIDELINE (JTS CPG) Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) for Hemorrhagic Shock (CPG ID:38)*.
- Ioffe, Y. J. M., Burruss, S., Yao, R., Tse, B., Cryer, A., Mukherjee, K., & Hong, L. J. (2021). When the balloon goes up, blood transfusion goes down: A pilot study of REBOA in placenta accreta spectrum disorders. *Trauma Surgery and Acute Care Open*, 6(1). <https://doi.org/10.1136/tsaco-2021-000750>
- Jauniaux, E., Hussein, A. M., Fox, K. A., & Collins, S. L. (2019). New evidence-based diagnostic and management strategies for placenta accreta spectrum disorders. In *Best Practice and Research: Clinical Obstetrics and Gynaecology* (Vol. 61, pp. 75–88). Bailliere Tindall Ltd. <https://doi.org/10.1016/j.bpobgyn.2019.04.006>
- Kamijo, K., Nakajima, M., Shigemi, D., Kaszynski, R. H., Ohbe, H., Goto, T., Sasabuchi, Y., Fushimi, K., Matsui, H., & Yasunaga, H. (2022). Resuscitative endovascular balloon occlusion of the aorta for life-threatening postpartum hemorrhage: A nationwide observational study in Japan. *Journal of Trauma and Acute Care Surgery*, 93(3), 418–423. <https://doi.org/10.1097/TA.0000000000003650>
- Kingdom, J. C., Hobson, S. R., Murji, A., Allen, L., Windrim, R. C., Lockhart, E., Collins, S. L., Soleymani Majd, H., Alazzam, M., Naaisa, F., Shamshirsaz, A. A., Belfort, M. A., & Fox, K. A. (2021). Minimizing Surgical Blood Loss at Cesarean Hysterectomy for Placenta Previa With Evidence of Placenta Increta or Placenta Percreta: The State of Play in 2020. *Obstetric Anesthesia Digest*, 41(2), 76–76. <https://doi.org/10.1097/01.aoa.0000744104.23225.05>

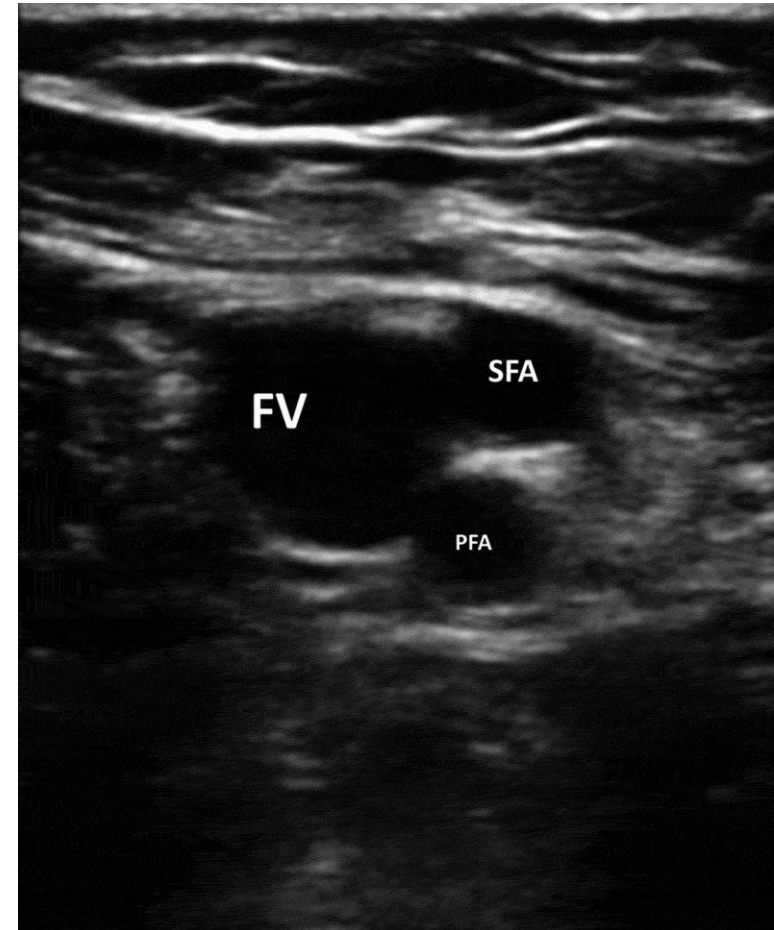
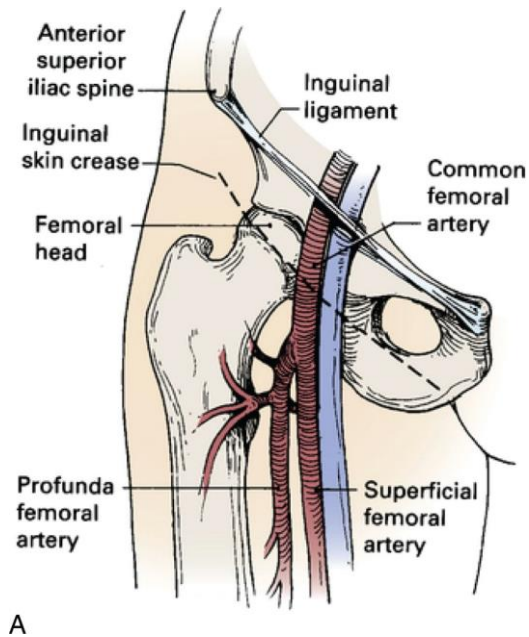
# References 2

- Lee, A. Y., Ballah, D., Moreno, I., Dong, P. R., Cochran, R., Picel, A., Lee, E. W., Moriarty, J., Padgett, M., Nelson, K., & Kohi, M. P. (2020). Outcomes of balloon occlusion in the University of California Morbidly Adherent Placenta Registry. *American Journal of Obstetrics and Gynecology MFM*, 2(1). <https://doi.org/10.1016/j.ajogmf.2019.100065>
- Kluck, S. L., Russo, R. M., Appel, N. B., Frankfurt, A. I., Weltge, C., Shimer, T., Feagins, B., Frotan, A., Rinehart, B., & Cohen, R. A. (2023). Aortic balloon occlusion in distal zone 3 reduces blood loss from obstetric hemorrhage in placenta accreta spectrum. *Journal of Trauma and Acute Care Surgery*, 94(5), 710–717. <https://doi.org/10.1097/TA.0000000000003917>
- Manzano-Nunez, R., Escobar-Vidarte, M. F., Naranjo, M. P., Rodriguez, F., Ferrada, P., Casallas, J. D., & Ordoñez, C. A. (2018). Expanding the field of acute care surgery: a systematic review of the use of resuscitative endovascular balloon occlusion of the aorta (REBOA) in cases of morbidly adherent placenta. *European Journal of Trauma and Emergency Surgery*, 44(4), 519–526. <https://doi.org/10.1007/s00068-017-0840-4>
- Manzano-Nunez, R., Escobar-Vidarte, M. F., Orlas, C. P., Herrera-Escobar, J. P., Galvagno, S. M., Melendez, J. J., Padilla, N., McCarty, J. C., Nieto, A. J., & Ordoñez, C. A. (2018). Resuscitative endovascular balloon occlusion of the aorta deployed by acute care surgeons in patients with morbidly adherent placenta: A feasible solution for two lives in peril. In *World Journal of Emergency Surgery* (Vol. 13, Issue 1). BioMed Central Ltd. <https://doi.org/10.1186/s13017-018-0205-2>
- Nieto-Calvache, A. J., Vergara-Galliadi, L. M., Rodríguez, F., Ordoñez, C. A., García, A. F., López, M. C., Manzano, R., Velásquez, J., Carbonell, J. P., Bryon, A. M., Echavarría, M. P., Escobar, M. F., Carvajal, J., Benavides-Calvache, J. P., & Burgos, J. M. (2021). A multidisciplinary approach and implementation of a specialized hemorrhage control team improves outcomes for placenta accreta spectrum. *Journal of Trauma and Acute Care Surgery*, 90(5), 807–816. <https://doi.org/10.1097/TA.0000000000003090>
- Ordoñez, C. A., Manzano-Nunez, R., Parra, M. W., Rasmussen, T. E., Nieto, A. J., Herrera-Escobar, J. P., Fernandez, P., Naranjo, M. P., García, A. F., Carvajal, J. A., Burgos, J. M., Rodriguez, F., & Escobar-Vidarte, M. F. (2018). Prophylactic use of resuscitative endovascular balloon occlusion of the aorta in women with abnormal placentation: A systematic review, meta-analysis, and case series. In *Journal of Trauma and Acute Care Surgery* (Vol. 84, Issue 5, pp. 809–818). Lippincott Williams and Wilkins. <https://doi.org/10.1097/TA.0000000000001821>

# References 3

- Riazanova, O. v., Reva, V. A., Fox, K. A., Romanova, L. A., Kulemin, E. S., Riazanov, A. D., & Ioscovich, A. (2021). Open versus endovascular REBOA control of blood loss during cesarean delivery in the placenta accreta spectrum: A single-center retrospective case control study. *European Journal of Obstetrics and Gynecology and Reproductive Biology*, 258, 23–28. <https://doi.org/10.1016/j.ejogrb.2020.12.022>
- Shamshirsaz, A. A., Fox, K. A., Erfani, H., Clark, S. L., Salmanian, B., Baker, B. W., Coburn, M., Shamshirsaz, A. A., Bateni, Z. H., Espinoza, J., Nassr, A. A., Popek, E. J., Hui, S. K., Teruya, J., Tung, C. S., Jones, J. A., Rac, M., Dildy, G. A., & Belfort, M. A. (2017). Multidisciplinary team learning in the management of the morbidly adherent placenta: outcome improvements over time. *American Journal of Obstetrics and Gynecology*, 216(6), 612.e1-612.e5. <https://doi.org/10.1016/j.ajog.2017.02.016>
- Stensæth, K. H., Carlsen, M. I. S., Løvvik, T. S., Uleberg, O., Brede, J. R., & Søvik, E. (2024). Resuscitative endovascular balloon occlusion of the aorta (REBOA) as adjunct treatment in life threatening postpartum hemorrhage: Fourteen years' experience from a single Norwegian center. *Acta Obstetrica et Gynecologica Scandinavica*, 103(5), 965–969. <https://doi.org/10.1111/aogs.14767>
- Whittington, J. R., Pagan, M. E., Nevil, B. D., Kalkwarf, K. J., Sharawi, N. el, Hughes, D. S., & Sandlin, A. T. (2022). Risk of vascular complications in prophylactic compared to emergent resuscitative endovascular balloon occlusion of the aorta (REBOA) in the management of placenta accreta spectrum. *Journal of Maternal-Fetal and Neonatal Medicine*, 35(16), 3049–3052. <https://doi.org/10.1080/14767058.2020.1802717>
- Ye, Y., Li, J., Liu, S., Zhao, Y., Wang, Y., Chu, Y., Peng, W., Lu, C., Liu, C., & Zhou, J. (2023). Efficacy of resuscitative endovascular balloon occlusion of the aorta for hemorrhage control in patients with abnormally invasive placenta: a historical cohort study. *BMC Pregnancy and Childbirth*, 23(1). <https://doi.org/10.1186/s12884-023-05649-8>
- Zhao, Y., Zou, L., Gao, H., Wu, D., Zhu, J. W., Liu, X. X., Zhang, W., Luo, L. B., Pan, Y., & Shi, D. D. (2020). Application of Modified Cesarean Hysterectomy for Patients with Placenta Previa Complicated with Placenta Percreta. *Maternal-Fetal Medicine*, 2(1), 17–22. <https://doi.org/10.1097/FM9.0000000000000026>

# Ultrasound Guidance: CFA Access



# *Femoral Arterial Access Complications*

- Dissection
- Pseudoaneurysm
- Thromboembolic
- Perforation
- Retroperitoneal hemorrhage

## Mitigate:

- Place in CFA, US guidance or cutdown
- Small sheaths (4-7French)

# *REBOA Balloon Complications*

- Vascular injury, rupture
- Balloon rupture

Mitigate:

- Gentle low volume inflation
- Monitor pressure and waveform

# *Reperfusion Complications*

- (Ischemia)
- Cell injury/death
- Acidosis
- Hyperkalemia
- Cytokine release
- Cardiac arrest
- Minimize occlusion time
  - Zone 1 <30 minutes
  - Zone 3 <60 minutes
- Anticipate and prepare