The Use of REBOA in trauma, acute care surgery and other emergency conditions

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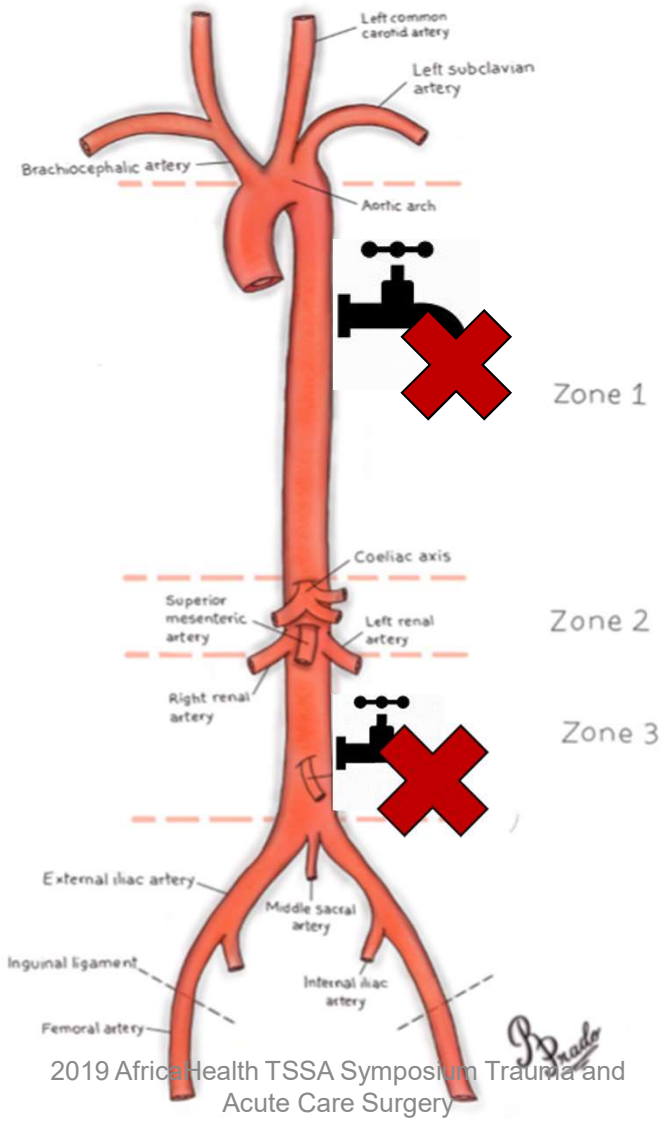
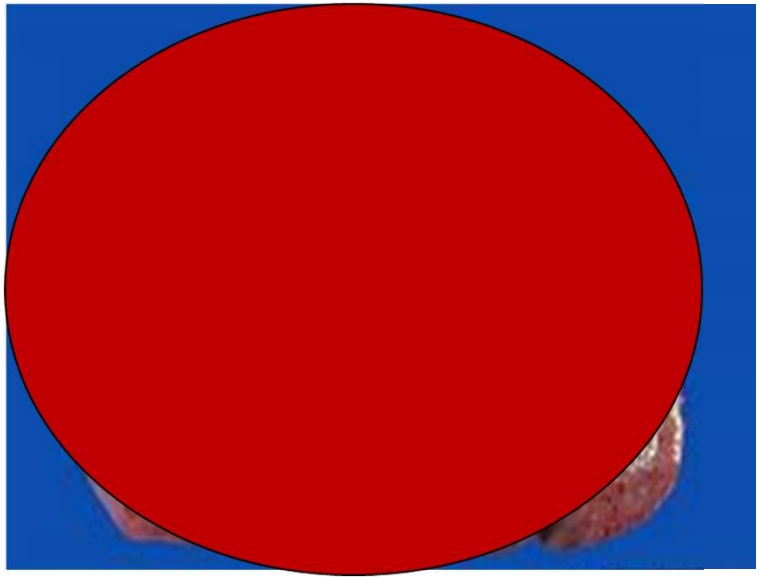

Left common carotid artery
Left subclavian artery
Brachiocephalic artery
Aortic arch
Zone 1
Coeliac axis
Superior mesenteric artery
Left renal artery
Zone 2
Right renal artery
Zone 3
External iliac artery
Middle sacral artery
Inguinal ligament
Internal iliac artery
Femoral artery

RUPTURED SPLEEN

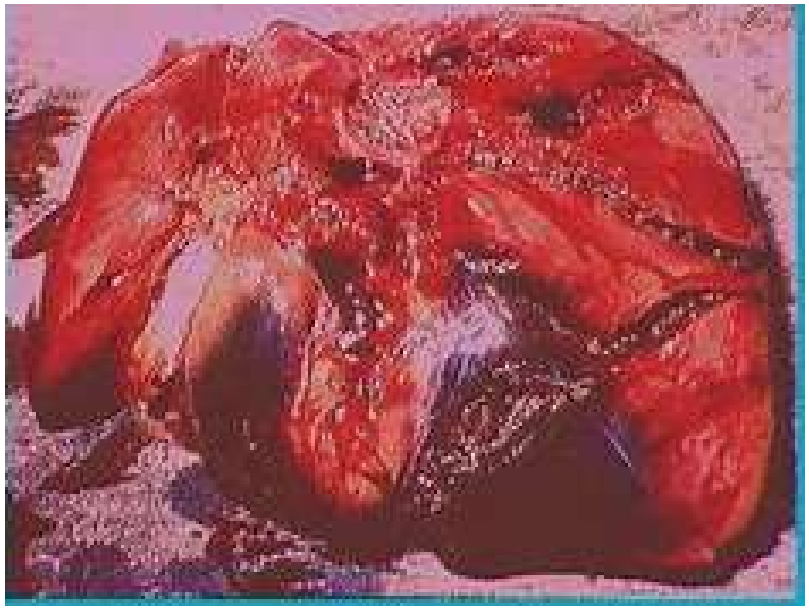
WITH REBOA

WITHOUT REBOA



RUPTURED LIVER

WITH REBOA



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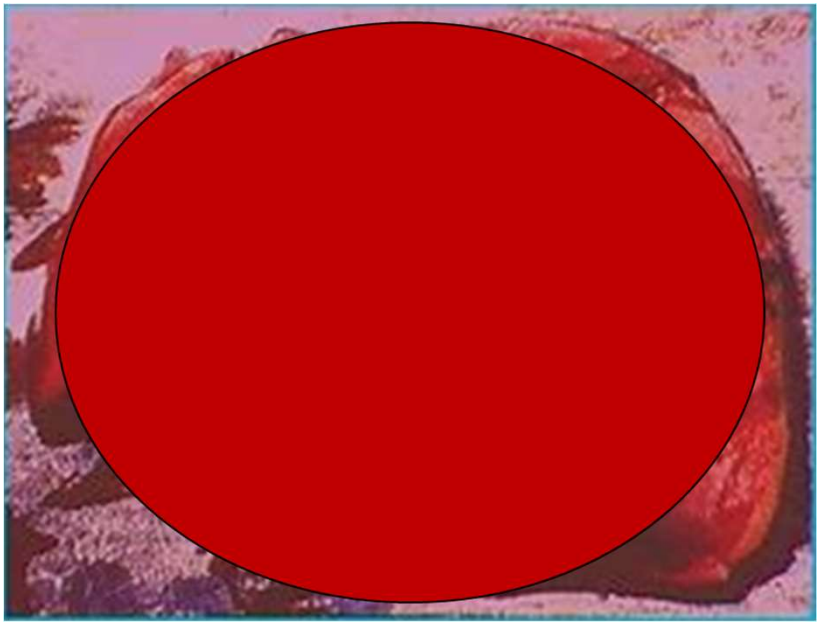


RUPTURED AORTIC ANEURYSM

WITH REBOA

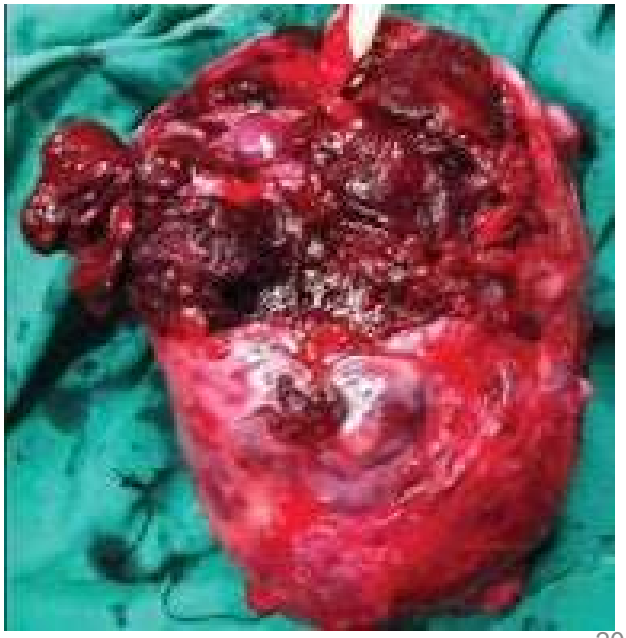
WITHOUT REBOA

NO BRAINER: AORTIC OCCLUSION IN rAAA since 2004

- Larzon T, Lindgren R, Norgren L. Endovascular treatment of ruptured abdominal aortic aneurysms: a shift of the paradigm? J Endovasc Ther. 2005;12(5):548-55.
- Malina M, Veith F, Ivancev K, et al. Balloon occlusion of the aorta during endovascular repair of ruptured abdominal aortic aneurysm. J Endovasc Ther. 2005;12(5):556-9.
- Berland TL, Veith FJ, Cayne NS, et al. Technique of supraceliac balloon control of the aorta during endovascular repair of ruptured abdominal aortic aneurysms. J Vasc Surg. 2013;57(1):272-5.
- Larzon T, Falkenberg M, Lonn L. The management of ruptured abdominal aortic aneurysms. J Cardiovasc Surg (Torino), 2014;55(2):133-5.
- Larzon T, Skoog P. One hundred percent of ruptured aortic abdominal aneurysms can be treated endovascularly if adjunct techniques are used such as chimneys, periscopes and embolization. J Cardiovasc Surg (Torino). 2014;55(2):169-78.
- Malina M, Holst J. Balloon control for ruptured AAAs: when and when not to use? J Cardiovasc Surg (Torino). 2014;55(2):161-7.

PLACENTA PERCRETA

WITH REBOA



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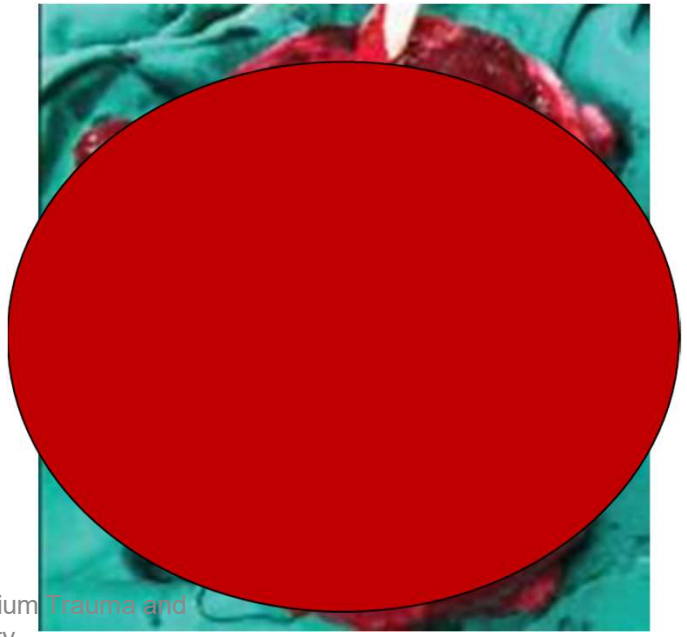
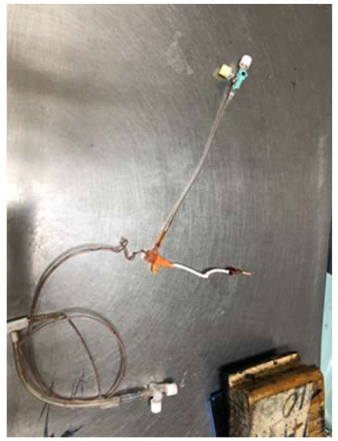


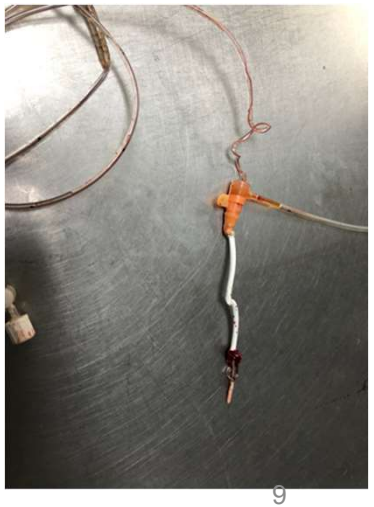
NO BRAINER 2: PLACENTA PERCRETA

- Balloon occlusion of the abdominal aorta during caesarean hysterectomy for placenta Percreta. Paull JD, Smith J, Williams L, Devine T, Holt M., Anaesth Intensive Care. 1995;23(6):731–4.
- Emergency use of a transfemoral aortic occlusion catheter to control massive haemorrhage at caesarean hysterectomy. Bell-Thomas SM, Penketh RJ, Lord RH, Davies NJ, Collis RBJOG., 2003;110(12):1120–2.
- Elective use of aortic balloon occlusion in caesarean hysterectomy for placenta previa Percreta. Gynecol Obstet Invest. 2009;67(2):92–5. Masamoto H, Uehara H, Gibo M, Okubo E, Sakumoto K, Aoki Y.
- Intraoperative aorta balloon occlusion: fertility preservation in patients with placenta previa accrete/increta. Panici PB, Anceschi M, Borgia ML, Bresadola L, Masselli G, Parasassi T, et al J Matern Fetal Neonatal Med. 2012;25(12):2512–6.
- Outcome of Pregnancies After Balloon Occlusion of the Infrarenal Abdominal Aorta During Caesarean in 230 Patients With Placenta Praevia Accreta; Wu Q, Liu Z, Zhao X , Chen Z et al; Cardiovasc. Intervent Radiol (2016) 39:1573–1579 (2012-2015)

Case 9: PLACENTA PERCRETA, CHBAH, 16/2/18:

- Known Placenta Percreta patient, on table in O.R. for 4r hours with no haemostasis ; internal iliac artery balloon catheters not working.
- Trauma Surgeon called to help
- Rescue REBOA in Zone 1: haemostasis achieved, 30 minutes full REBOA, 30 minutes pREBOA.
- Unable to remove balloon, removed later with sheath by vascular surgeons: diminished pulses: required arteriotomy, thrombectomy, good outcome
- **<u>HIGHLIGHTS:</u> LIVING PROOF THAT SEVERE PLACENTA PERCRETA MAY NEED ZONE 1 CONTROL, AND REMOVING BALLOONS THROUGH SIZE 7 MAY BE DIFFICULT**

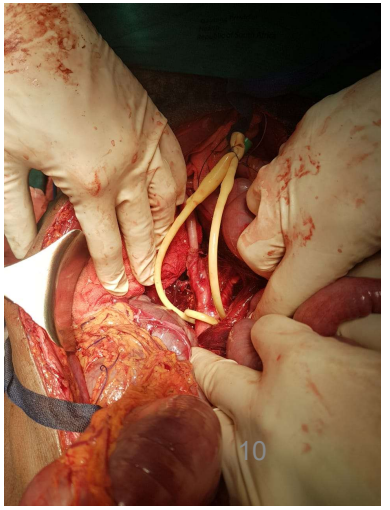




Case 12:EXTENSIVE PLACENTA PERCRETA: 26/3/18 Planned REBOA

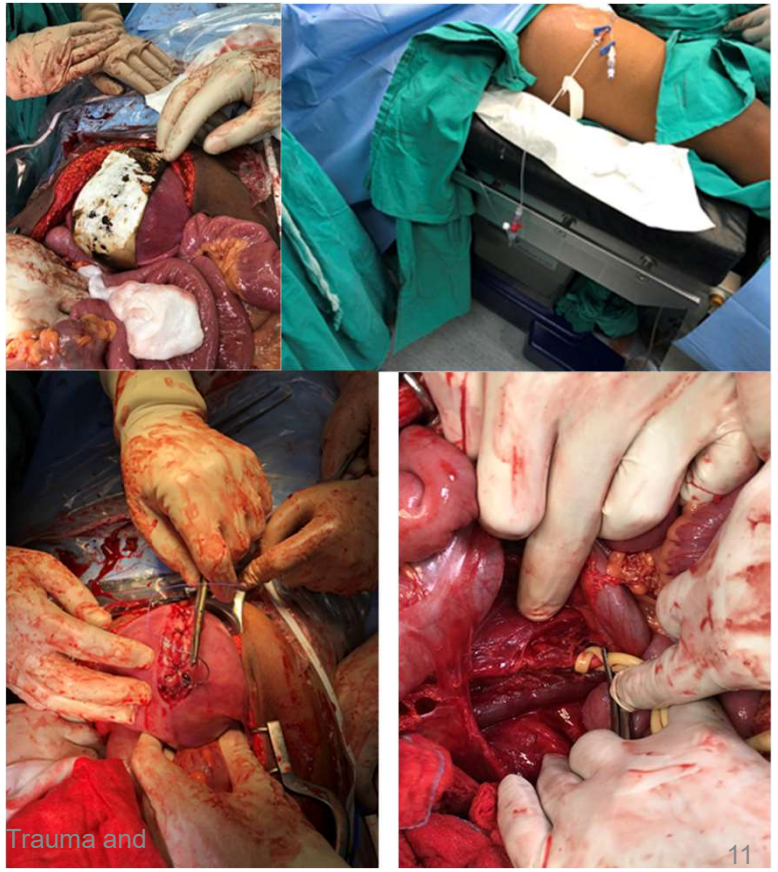
- 42 year old
- G4P2 at 33/40
- Prev C/S x 2; 1 TOP
- No other co-morbidities
- Extensive placenta adhesions
- Zone 1 then Zone 3 with stylet in place
- On re-introducing to zone 1: ruptured
- Zone 3 Foley's around aorta
- Iliac artery damage by sheath
- Arterial repair

HIGHLIGHTS: DETAILED PLANNING, REINTRODUCTION OF STYLET CAUSED PROBLEMS AND OPEN CROSS CLAMPING ALLOWED CONCLUSION OF PROCEDURE



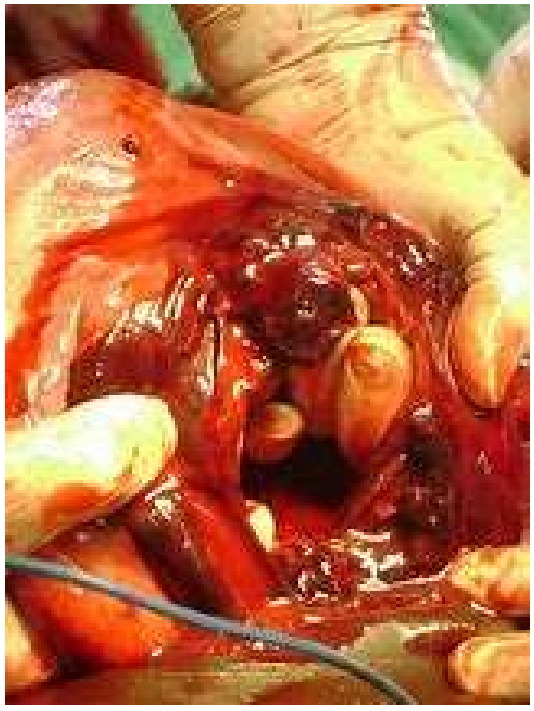
Case 16: PLACENTA PERCRETA: CHBAH: 18/5/18

- Tiny 15 year old P0, G1
- Standard CVP line in CFA, ready for sheath insertion
- Foley's catheter around infrarenal aorta after hysterotomy and delivery
- Complete and partial Zone 3 clamping while ongoing bleeding from uterus
- **HIGHLIGHTS: AORTIC LOOP AVOIDED INSTRUMENTATION OF SMALL VESSELS AND COST SAVING**
  - **20 000 DELIVERIES/YEAR AT CHBAH: 40 PP/YEAR**



RUPTURED UTERUS

WITH REBOA



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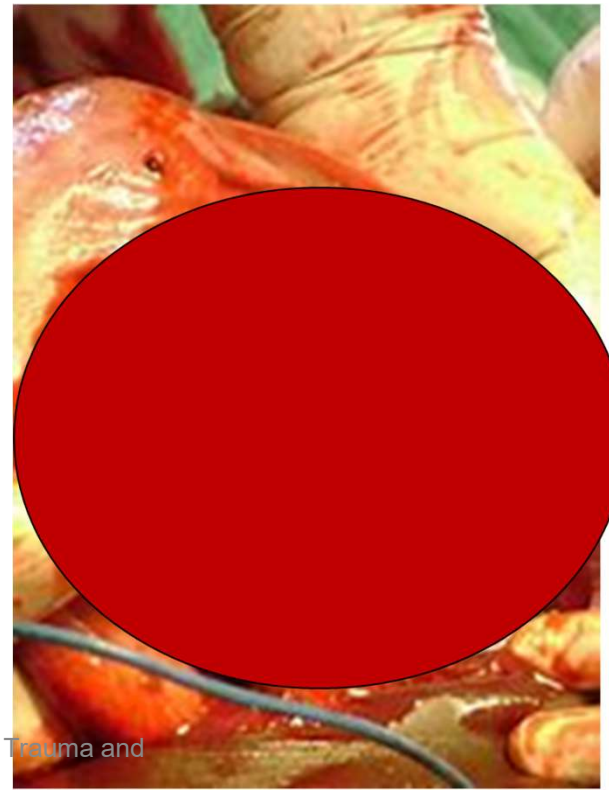


Case 3: BLUNT, NetCare Union Hospital, 16/9/17

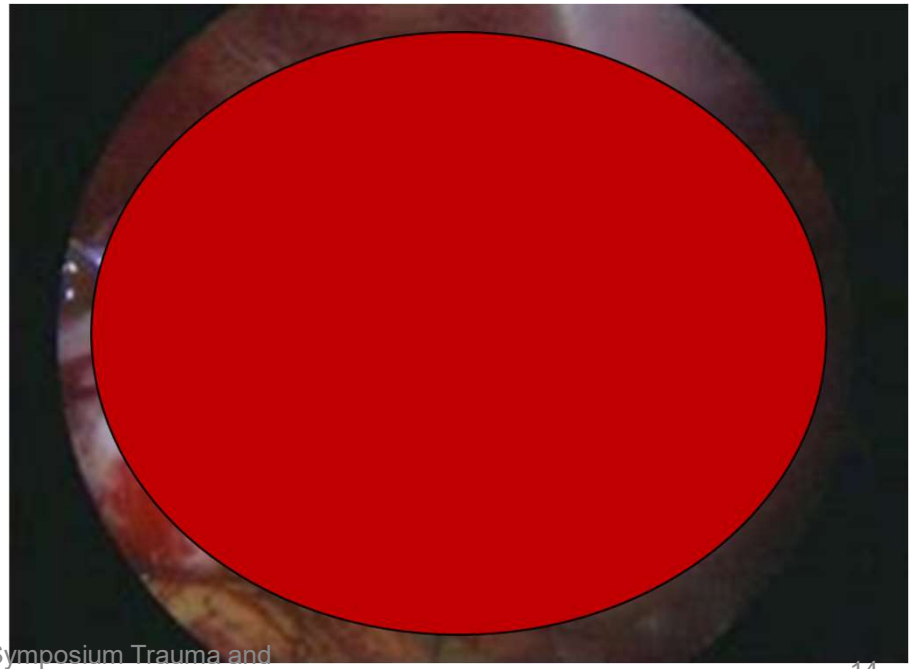
- 29 year old female, 28/40, dead foetus, abruptio placentae, open book pelvis and other pelvic fractures, mesenteric bleeds, massive scalp lacerations, entrapped x 30 minutes,
- SBP 70, dropped to 50, REBOA inserted with US on confirmation of foetal death on way to OR, 30 min total, 45 min partial zone 1
- Uterine evacuation, pelvic packing, relook, internal fixation, etc.

HIGHLIGHTS: REBOA TEMPORIZING UNTIL OBSTETRICIAN AND TEAM ARRIVED AND O.R. READY

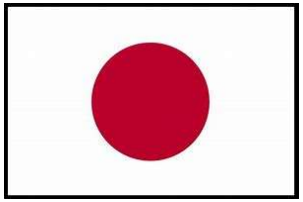
RUPTURED ECTOPIC PREGNANCY

WITH REBOA

WITHOUT REBOA



PRACTICAL USE OF IABO (INTRA-AORTIC BALLOON OCCLUSION) IN GENERAL SURGERY, Kubota T, 2018 ECTES

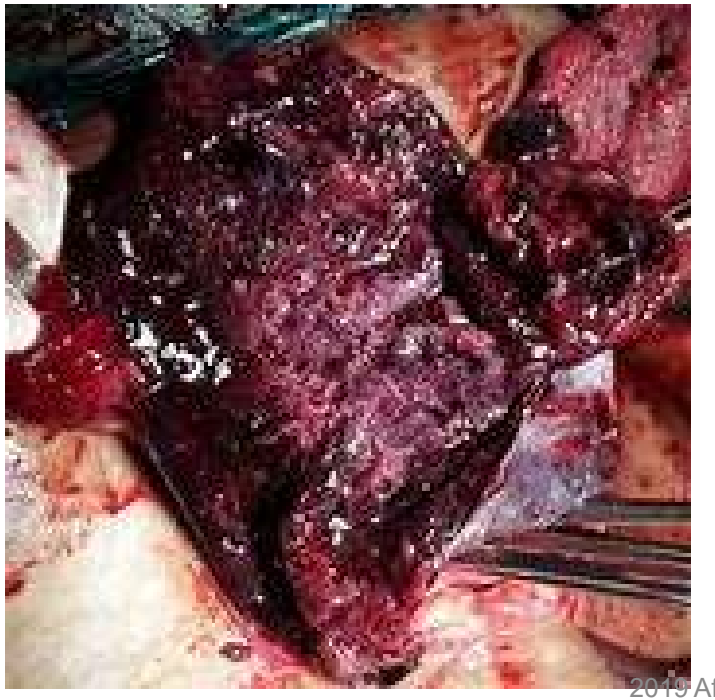


Case 1 : Ruptured pseudo aneurysm of the GDA (gastro-duodenal artery).Severe necrotizing pancreatitis with massive gastrointestinal bleeding

Case 2: Advanced pancreatic head cancer, pancreatico-duodenectomy. Massive bleeding from a side hole of the SMA : REBOA allowed hole of the SMA to be easily sutured.

Ruptured Tumour

WITH REBOA



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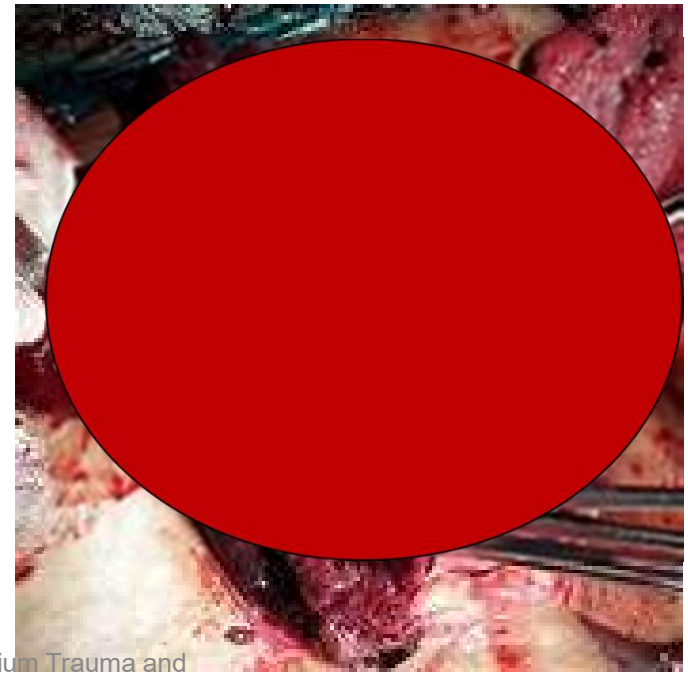
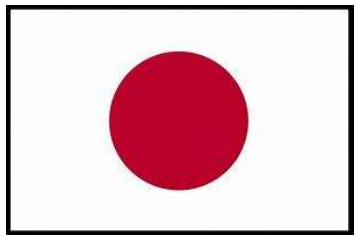
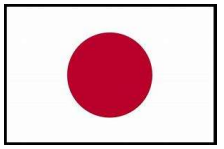


Non-traumatic haemorrhage is controlled with REBOA in acute phase then mortality increases gradually by non-haemorrhagic causes: DIRECT-IABO registry in Japan Matsumura Y, Matsumoto J, Idoguchi K et al; Eur J Trauma Emerg Surg, 2017



- Gastrointestinal bleeding, obstetrics and gynaecology, visceral aneurysm, AAA, post-abdominal surgery. (36 out of 142 patients)
- The abdomen was a common bleeding site (69%), followed by the pelvis or extra-pelvic retroperitoneum.
- Non-traumatic haemorrhagic shock often resulted from a single bleeding site, and resulted in better 24-h survival than traumatic haemorrhage among Japanese patients who underwent REBOA.
- However, hospital mortality increased steadily in non-trauma patients affected by non- haemorrhagic causes after a longer period of critical care.

Resuscitative endovascular balloon occlusion of the aorta for uncontrollable nonvariceal upper gastrointestinal bleeding, Sano H, Tsurukiri J, Hoshiai A et al; World Journal of Emergency Surgery (2016) 11:20



- REBOA can be performed with a high degree of technical success and is effective at improving hemodynamic in patients with UGIB.
- Important factors: Total occlusion time, high lactate levels, clinical Rockall score, and age

BLEEDING PEPTIC ULCER

WITH REBOA

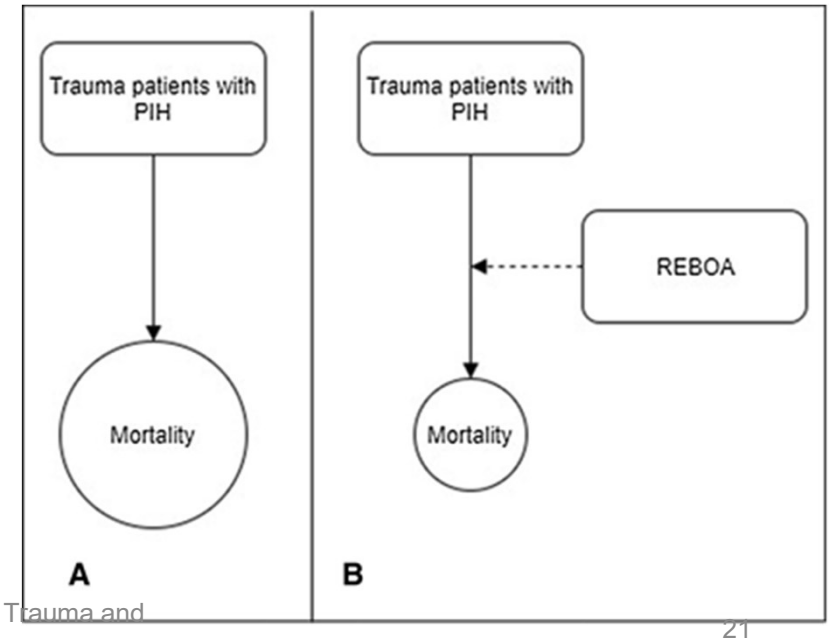
WITHOUT REBOA

Endovascular Resuscitation with Aortic Balloon Occlusion in Non-Trauma Cases: First use of ER-REBOA in Europe; McGreevy D, Dogan E ,Toivola A, Bilos L, Pirouzram A, Nilsson KF, Hörer TM; 2017 JEVTM; Vol. 1, No. 1; pp 42–49

- Ruptured Pseudoaneurysm post Whipple
- Bleeding gastric ulcer
- Massive bleeding from ventral and dorsal rectal wall
- ETC, ETC
- More to come, I am sure

Could resuscitative endovascular balloon occlusion of the aorta improve survival among severely injured patients with PIH (post-intubation hypotension)? Nunez AR, Herrera-Escobar JP, Ordonez CA, Moore EE et al; European Journal of Trauma and Emergency Surgery 2018

- Proactive aortic control obtained with REBOA could be paramount for mitigating the deleterious physiologic anomalies that occur after intubation
- Consider deployment of REBOA for the prevention of PIH in patients with traumatic haemorrhagic shock



REBOA IN CPR for non trauma related cardiac arrest?

The role of resuscitative endovascular balloon occlusion of the aorta (REBOA) as an adjunct to ACLS in non-traumatic cardiac arrest: Daley J, Morrison JJ, Sather J, Hile L: American Journal of Emergency Medicine 2017 (35) 731-5

- Balloon occlusion of the aorta: Method of circulatory support in the critically ill patient
- Intra-aortic balloon pumps used in cardiogenic shock for decades.
- One hundred cardiac arrest patients: Strong association between ROSC and a coronary perfusion pressure greater than 15 mm Hg
- Increases in coronary perfusion pressure during ACLS followed by improvements in cerebral perfusion pressure and enhanced cerebral oxygenation

Traditional ACLS is often unable to maintain the circulatory support required for ROSC and the preservation of neurologic function.

Improved outcomes in NTCA using continuous balloon occlusion of the aorta

- Nine animal studies: Meaningful increases in coronary artery flow and coronary perfusion pressure, and improvement in ETCO2

Case 11: CARDIAC WITH MINOR TRAUMA, NetCare Union Hospital, 19-23/3/18 (RIP)

- 55 year old cardiac patient, previous MI, collapsed while pushing car uphill, trapped under car for 30 ‘
- Arrest at scene at extrication, intubated, and ROSC, arrived on adrenaline, SBP 80, dropped to SBP of 30 after 5 ‘
- Echo: minimal ventricular activity
- REBOA inserted blind: SBP to 130, return of good cardiac contractility
- REBOA up for 17’, then deflated
- Pan Scan: no injuries; laceration buttock only
- Coronary angio: 80% occlusion LASD, circumflex, right coronary: stented
- Improved but in AKI, CCVHD, weaned off vent
- Day of death: sudden deterioration, no right heart function, RIP

HIGHLIGHTS: REBOA FUNCTIONNED AS INTRA-AORTIC BALLOON TO ALLOW FOR SOME CORONARY PERFUSION, ALLOWED CT SCAN

Case 5: CARDIAC AND BLUNT: NetCare Union Hospital: 8/10/17 (RIP)

- 77 year old man, cardiac patient on warfarin, beta blockers, chronic renal failure, 2 previous MIs, malfunctioning pacemaker, suspected new MI as cause, lost control, ejected
- Hangman's fracture, partial avulsion right kidney, ruptured diaphragm, liver, multiple right sided rib fractures, Head injury GCC 9/15. No abdominal fluid on U/S, possible retro-peritoneal haematoma right flank
- No emergency blood available
- Arrived with SBP 30/20 on adrenaline, poor cardiac contractility: REBOA with good results SBP up to 110, anaesthetist/ OR only available IN 1 HOUR.
  - 30 min complete, 30 min pREBOA before OR. CT scan with partial REBOA, no contrast
- Stabilizing, but renal vein off IVC, DOT after 4 hours
- **HIGHLIGHTS: WITH UNCERTAIN DIAGNOSIS, CHRONIC CONDITIONS ONLY KNOWN LATER, REBOA IMPROVED CARDIAC OUTPUT AND KEPT HIM ALIVE UNTIL FAMILY ARRIVED ABD ASKED FOR EVERY ATTEMPT TO BE MADE**

CONCLUSIONS

- **The treatment of bleeding is to stop the bleeding**
- **REBOA and hybrid methods allow optimization of perfusion above and hypotensive resuscitation below**
- **Support of myocardial function and coronary perfusion helps in cardiac cases**
- **The practice of endovascular aortic control must spread beyond trauma, the same way principles of damage control surgery, open abdomen, clip and drop have been extended from trauma to general surgical catastrophes**
- **Trauma and acute care surgeons are the ideal champions to promulgate this form of bleeding control to all other branches of surgery and emergency medicine**