Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) Clinical Guideline

Scope

Site	Department, Division or Operational Area	Applicable to
Royal Perth Hospital (RPH) only	Surgical Division, State Major Trauma Unit (SMTU), Hospital Logistics and Acute Access Division (HoLAA), Emergency Department (ED)	Medical

Preamble

Resuscitative endovascular balloon occlusion of the aorta (REBOA) is a feasible technique to assist the treatment of severe haemorrhagic shock due to non- compressible truncal haemorrhage (NCTH) in trauma.[1,2] NCTH is defined as haemorrhage arising from trauma to the torso vessels, pulmonary parenchyma, solid abdominal organs and disruption of the bony pelvis. REBOA provides the trauma team with a modern alternative in the situation where a left anterolateral thoracotomy would have historically been performed to cross-clamp the descending thoracic aorta.

Links within document

- Appendix I – Equipment
- Appendix II – Algorithm for the Management of Profound Haemorrhagic Shock Secondary to Uncontrolled Truncal and Extremity Bleeding

Rationale

Haemorrhage leads to cardiovascular collapse and death unless myocardial and cerebral perfusion can be maintained. In the setting of NCTH resulting in hypotension or shock, external cardiac compression has not proven beneficial. Rather, resuscitative aortic occlusion (RAO) for NCTH mitigates haemorrhage and increases afterload and central aortic pressure until haemostasis can be achieved.

RAO has traditionally required a thoracotomy or a laparotomy for aortic exposure. For trauma patients in extremis, this procedure occurs in the resuscitation bay where a left thoracotomy and direct aortic compression are performed to evaluate and treat reversible causes of cardiovascular collapse. The resuscitative thoracotomy has a high mortality rate, significant potential for casualty and trauma team morbidity, and high resource utilisation, due largely to the nature of the injuries leading to arrest.[3]

REBOA is an alternative to resuscitative thoracotomy. REBOA is performed using trans-femoral arterial access to facilitate aortic occlusion and allow both monitoring and support of the central circulation in patients at risk of imminent cardiovascular collapse.

Diagnostic criteria

Consider REBOA in patients with profound shock due to the following - either in isolation or in combination:

- Uncontrolled intra-abdominal haemorrhage
- Uncontrolled pelvic haemorrhage

Relative contraindications

- Aortic rupture
- Intra-thoracic/supradiaphragmatic haemorrhage
- Need for other resuscitative manoeuvres during ED Thoracotomy, such as internal cardiac massage
- Elderly patients (due to likely atheromatous vessels)
- Patients with aortic and peripheral vascular disease
- Unavailability of an appropriate surgical or endoluminal intervention for definitive control of source of haemorrhage

Personnel

The REBOA procedure will be performed by the trauma team as an adjunct to the Primary Survey. The vascular access and device should be deployed by a practitioner skilled in both percutaneous and open vascular access of the common femoral artery, skilled in use of the devices, and skilled in the open vascular repair of the common femoral artery following removal of the sheath.

A surgical assistant (e.g. the Trauma Fellow/Surgical Registrar) should also scrub to assist the surgeon performing the procedure.

Setup in the trauma resuscitation bay

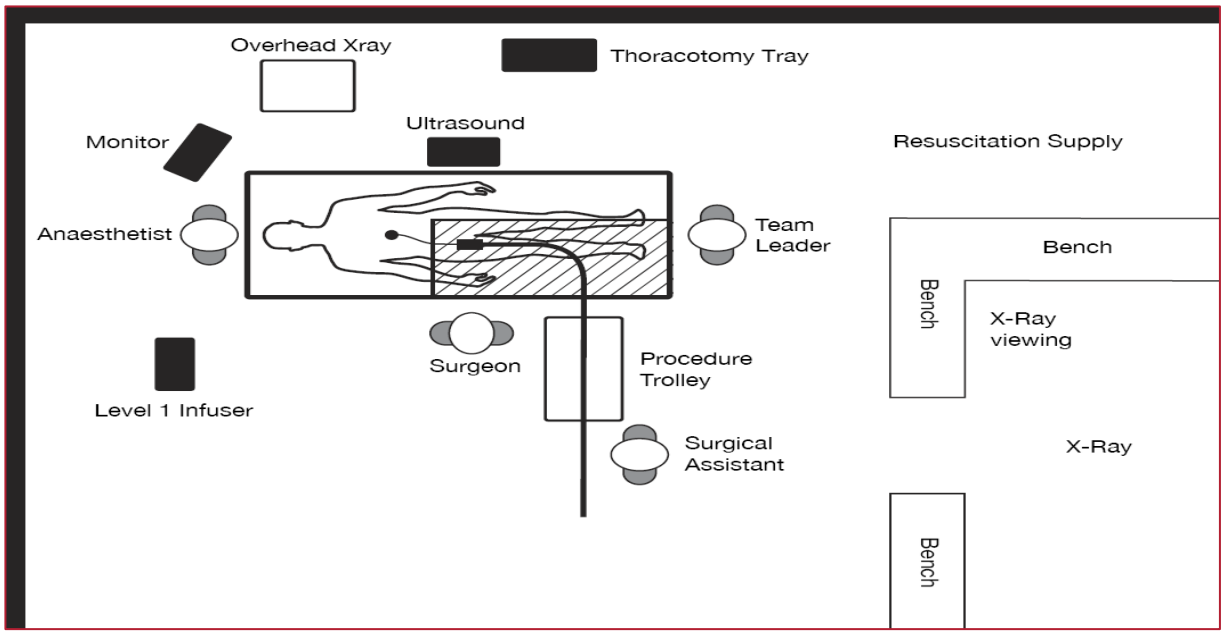


Figure 1: Setup in the Trauma Resuscitation Bay

Equipment

A red storage box labelled “REBOA” is kept in the Medical Officer’s office on the SMTU. It contains two complete sets of equipment for the REBOA procedure:

- Minor Instrument Pack and Sterile Draping Pack (drape, bowls, gauze swabs etc.)
- 2 x Cook access needle 18fg
- Arrow central venous catheter (CVC) line kit
- 8Fr CORDIS 35cm introducer sheath, with dilator (Zone 1) (Ref: 401-835M)
- 8Fr TERUMO 10cm introducer sheath (Zone 3) (Ref: RB*B8SN10MC) with guide wire
- 7Fr Tokai Rescue Balloon Occlusion Catheter (Culpan Medical; Ref: RB-167080- E) with guide wire
- 5FR TERUMO 10cm introducer sheath (for potential angiogram other groin)
- Intravenous contrast (to be diluted 1:3 with saline) for the balloon (available from ED computerised tomography [CT] scanner)
- 2 x 20mL Luer-lock syringes

The remainder of equipment (gowns, gloves, surgical prep, a trolley, etc.) are available in the ED.

The REBOA Box should accompany the patient at all stages of the resuscitation until the balloon has been removed.

The REBOA box will be restocked by the Consultant Trauma Surgeons: the equipment is not to be removed from the box without expressed permission.

Pictures of the REBOA box and individual equipment are illustrated in Appendix I

Technique

- Following the trauma team's decision to use REBOA, both groins are prepared with chlorhexidine gluconate 1% in ethanol. The overlying pelvic binder may be required to be partially cut away
- The common femoral artery is accessed either percutaneously (either by palpation of pulse or ultrasound [US] guidance), or by direct surgical cut-down. The technique will depend on the patient's haemodynamics, the patient's physical parameters including injuries and obesity, and the Surgeon's personal preference.
- The common femoral artery (CFA) is accessed using a Cook needle (or with the puncture needle from an Arrow CVC kit), and either the 7Fr Tokei guide wire (**Zone 1**) or the 8Fr TERUMO guide wire (**Zone 3**) is introduced. This is performed without fluoroscopic guidance. If resistance is encountered the procedure should be reconsidered. A check Xray can then be used to confirm the wire is overlying the aortic position in the abdomen (compared to a likely inferior vena cava [IVC] location, or aberrant deflection into a vascular branch)
- The needle is then removed, and the dilator and sheath advanced on the wire and into the artery. An approximately 1cm skin incision will be necessary to facilitate the sheath's entry. The dilator is then removed, leaving the wire and sheath in place
- The Tokei rescue balloon is finally advanced over the wire to a predetermined position
- For a Zone I deployment the distance is estimated from the groin to just superior to the xiphisternum, and for a Zone III deployment the distance is estimated from the CFA to just above the umbilicus.

Technique cont'd

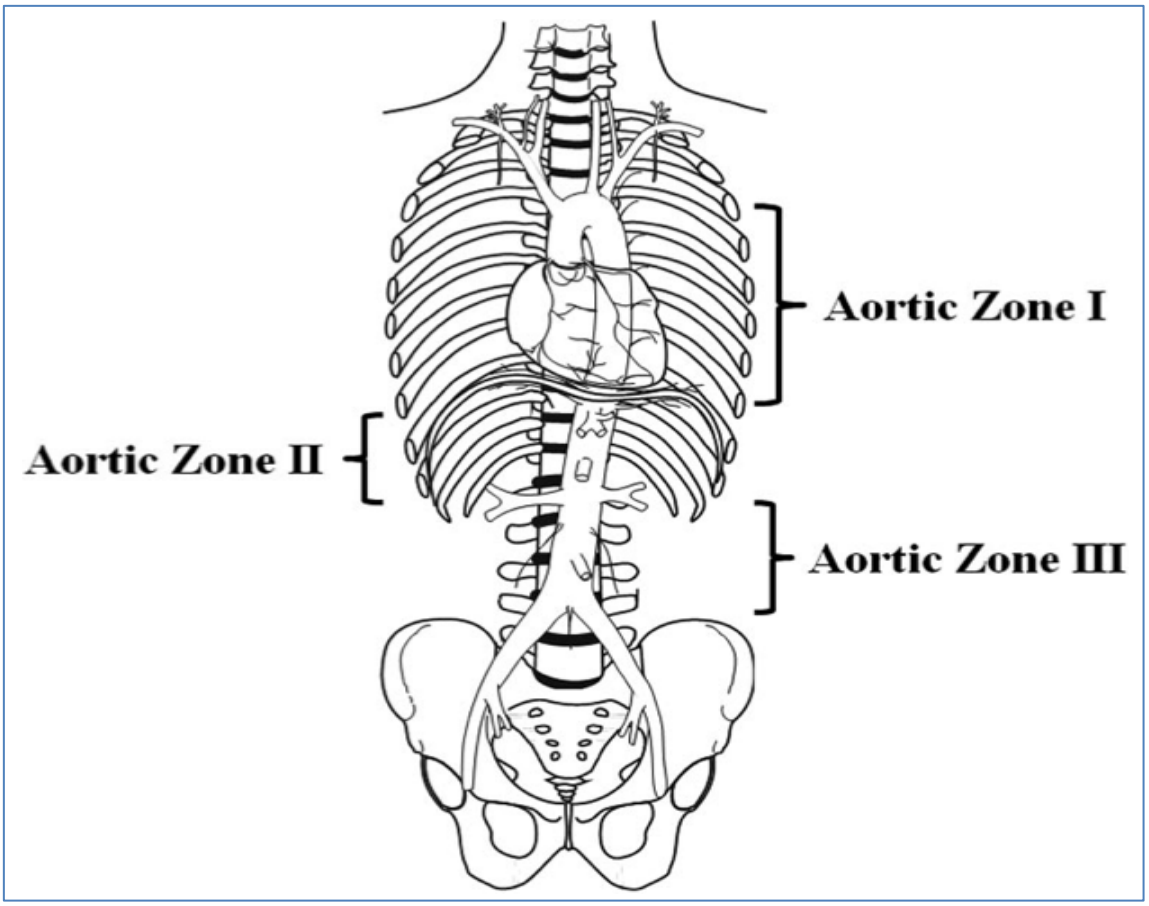


Figure 2: Aortic Zones

Zone I is from the take-off of the left subclavian artery down to the celiac trunk. Zone II is from the celiac trunk to the lowest renal artery. Zone III is from the lowest renal artery to the bifurcation[4].

- The estimated length of the balloon required may be marked on the balloon with a sterile indelible marker
- A confirmation plain abdominal Xray may be used at this stage to identify the position of the balloon before inflation
- If an appropriate position has been located, 15 - 20 mL of 1:3 contrast/saline mixture is instilled into the balloon. A repeat confirmation plain abdominal Xray may then be performed
- For Zone I deployment, the balloon should ideally be placed at the level of T11. Aortic occlusion at a higher level may cause spinal cord ischaemia.

Technique cont'd

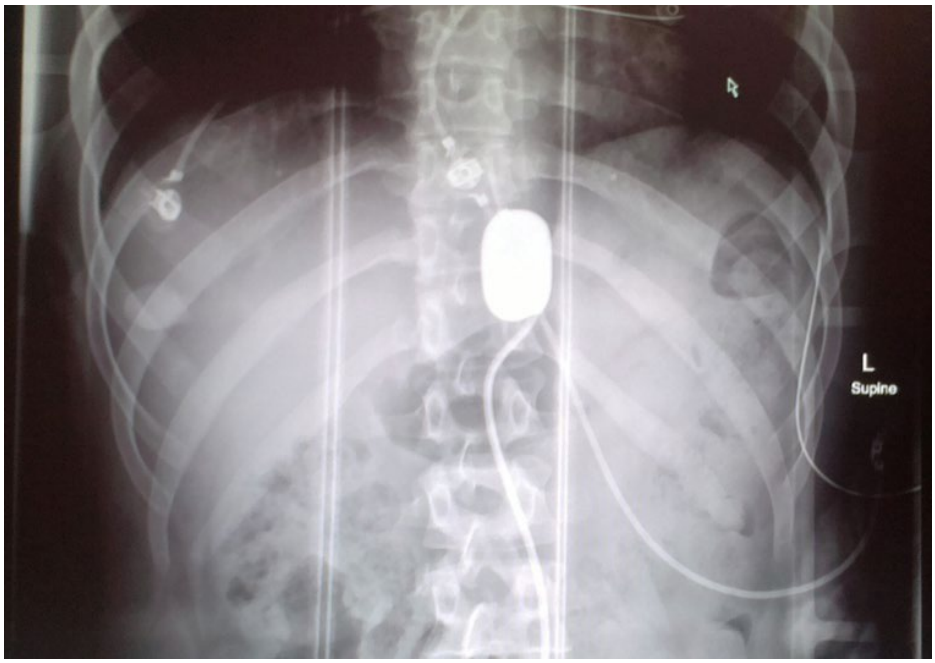


Figure 3: Abdominal Xray of a Zone I level deployment for both intra-abdominal and pelvic haemorrhage (1st Case at Royal Perth Hospital, 6 October, 2014)

- The wire is finally removed. If an arterial line is not available, the "distal" lumen of the rescue balloon may be transduced to provide this information
- Ensure the balloon and sheath are firmly secured prior to transport, particularly as the balloon may be prone to migrate with changes to central aortic pressure.

The patient is then expeditiously transferred to Theatre or Interventional Radiology, as appropriate, for definitive vascular control, while the goal directed resuscitation is continued.

Deflation of the balloon

Key alert

To minimise tissue ischaemic injury, the balloon should be deflated as soon as possible.

- Communication with the assistant holding the apparatus and the Anaesthetic team is critical before consideration of balloon deflation
- Once a decision to attempt deflation is made, care must be taken to turn the three-way stopcock and deflate the balloon slowly as this step can be anticipated to result in a significant decrease in afterload and reperfusion type effects on the circulatory system
- The main operator should be the person to deflate the balloon while the identified assistant continues to hold the balloon and sheath in the desired location
- After prolonged balloon inflation or in situations where incomplete resuscitation has occurred, deflation of the balloon can be expected to result in reperfusion, washout of metabolic by-products, and acidosis. As such, intermittent balloon inflation and deflation may be necessary until some hemodynamic stability is restored.

Removal of the balloon and sheath

- After REBOA is no longer required, the deflated balloon may be removed from the large sheath, which should then be flushed with 100mL of heparinised saline (1,000 units of heparin in 1L of 0.9% sodium chloride)
- The large diameter sheaths required to deploy currently available compliant balloons are best removed with open surgical exposure of the femoral artery and surgical closure of the arteriotomy.

Facilitator

Judith Cuff, Divisional Safety & Quality Coordinator, Innovation and Education

Review authors

RPH Trauma Service
RPH Trauma Committee, comprising representatives from Trauma, Anaesthesia, Emergency Department, Orthopaedics, Neurosurgery, Intensive Care, Nursing, Imaging, Theatres

References

1. Brenner, Megan L. MD; Moore, Laura J. MD; DuBose, Joseph J. MD; Tyson, George H. MD; McNutt, Michelle K. MD; Albarado, Rondel P. MD; Holcomb, John B. MD; Scalea, Thomas M. MD; Rasmussen, Todd E. MD (2013). *A clinical series of resuscitative endovascular balloon occlusion of the aorta for hemorrhage control and resuscitation. Journal of Trauma and Acute Care Surgery. 75(3):506-511, September 2013.*Accessed August 2021. https://oce-ovid-com.smhslibresources.health.wa.gov.au/article/01586154-201309000-00024/PDF
2. Saito N, Yagi T, Matsumoto H & Mashiko K (2014) *Evaluation of the safety and feasibility of resuscitative endovascular balloon occlusion of the aorta in Japan*. Presented at: 73rd Annual Meeting of the American Association for the Surgery of Trauma. Philadelphia, USA. September, 2014**.** Accessed August 2021 https://oce- ovid-com.smhslibresources.health.wa.gov.au/article/01586154-201505000-00001/PDF
3. Joint Theatre Trauma System Clinical Practice Guideline*. Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) for Haemorrhagic Shock*. 9 June 2017. Accessed August 2021 http://prytimemedical.com/wp-content/uploads/2017/07/REBOA_-CPG_FINAL.pdf
4. Stannard A, Eliason JL & Rasmussen TE (2011) Resuscitative endovascular balloon occlusion of the aorta (REBOA) as an adjunct for hemorrhagic shock. *J Trauma*. 71(6): 1869-72. Accessed August 2021 https://www.ncbi.nlm.nih.gov/pubmed/22182896

Related policies, practice standards, clinical guidelines

RPBG Policy Hub

- Emergency Department Thoracotomy Clinical Guideline
- Emergency Department: Thoracotomy and Internal - Role of the Nurse Assisting SOP
- Penetrating Abdominal, Thoracoabdominal and Chest Trauma Management Clinical Guideline

Related national standards

ACSQHC NSQHS Standards 2nd Edition (2021)

Standard 1: Clinical Governance

Standard 6: Communicating for Safety

Standard 8: Recognising and Responding to Acute Deterioration

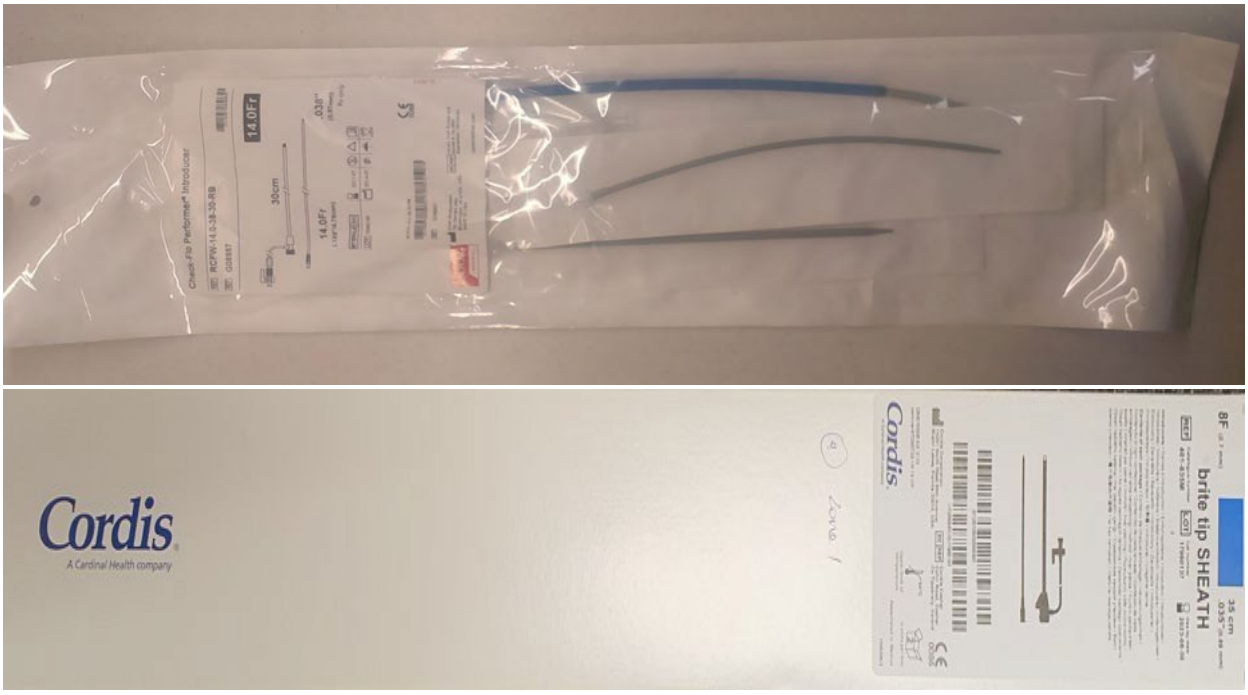
Appendix I: Equipment

The REBOA Kit

COOK access needle 18fg

Appendix I: Equipment cont'd

CORDIS 8Fr **Zone 1** Long (35cm) introducer sheath Ref: 401-835M

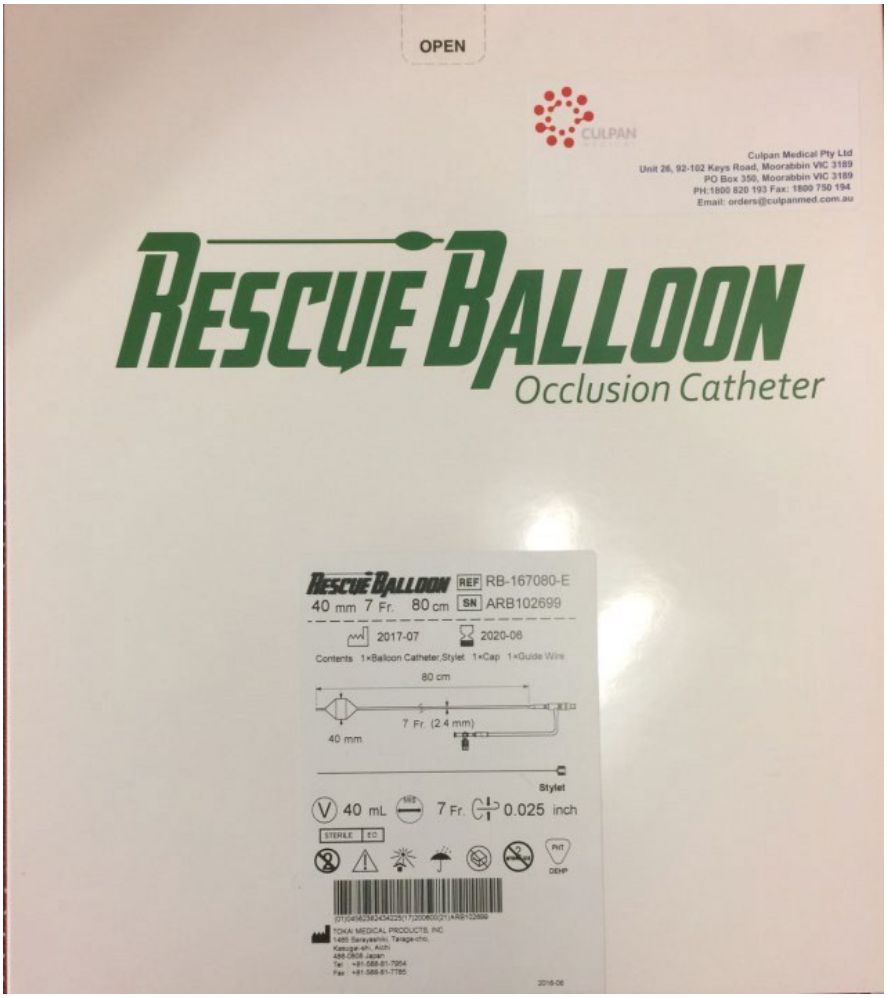


TERUMO **Zone 3** Short (10cm) introducer sheath with guide wire

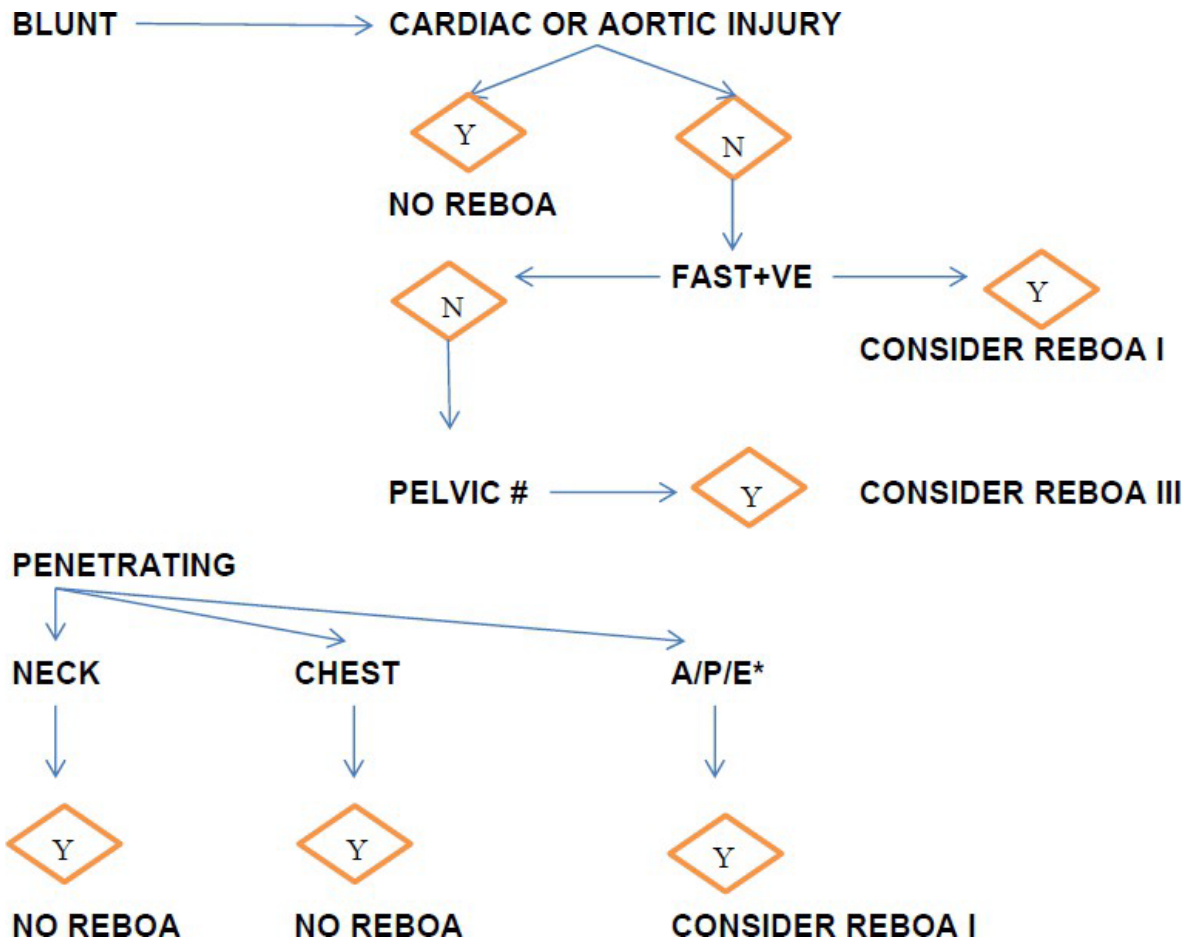
TERUMO 5Fr (**angiogram**) introducer sheath (use CVC guide wire)

Appendix I: Equipment cont'd

7Fr Tokai Rescue Balloon Occlusion Catheter with guide wire



Appendix II: Algorithm for the management of profound haemorrhagic shock secondary to uncontrolled truncal and extremity bleeding 3



*Abdomen/Pelvis/Extremity:
REBOA I - Placement of aortic balloon in the distal thoracic aorta (at the level of the diaphragm)
REBOA III - Placement of aortic balloon directly above the aortic bifurcation ensuring the abdominal viscera remain perfused.