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

Scope

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Related Policy, RPBG Practice Standard, Clinical Guidelines

- Emergency Department Thoracotomy Clinical Guideline
- Trauma Service Guideline: Penetrating Abdominal, Thoracoabdominal and Chest Trauma Management

Related National Standards

- NSQHS Standard 9: Recognising and Responding to Clinical Deterioration in Acute Health Care

Preamble

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.

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 for NCTH mitigates haemorrhage and increases afterload and central aortic pressure until haemostasis can be achieved.

Resuscitative aortic occlusion (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 morbidity and mortality rate, due largely to the nature of the injuries leading to cardiac arrest\(^3\). In addition there is significant potential for occupational injury to the trauma team.
Resuscitative endovascular balloon occlusion of the aorta (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:
- Uncontrolled intra-abdominal haemorrhage
- Uncontrolled pelvic haemorrhage
(Either in isolation or in combination)

Relative Contraindications
- Aortic rupture
- Intra-thoracic/supradiaphragmatic haemorrhage
- Need for other resuscitative manoeuvres during Emergency Department 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
Equipment

A red storage box labelled “REBOA” is kept in the RMO’s office on the State Major Trauma Unit. It contains two complete sets of equipment for the REBOA procedure:

- A vascular-type drape
- Cook access needle (the needle from an Arrow CVC line kit is an alternate)
- 260cm Amplatz guide wire x 2
- 14Fr Cook introducer sheath, with dilator and Cook CODA balloon
- 7Fr Tokai Rescue Balloon Occlusion Catheter (Culpan Medical; Ref: RB-167080-E)
- Intravenous contrast (to be diluted 1:3 with saline) for the CODA balloon (available from ED CT scanner)
- 20mL luer-lock syringes
- Sterile indelible marker
- Norfolk &Norwich retractor to supplement the equipment from the thoracotomy tray in the case of an open vascular dissection in an obese patient

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

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 express permission.

Pictures of the REBOA box and individual equipment are illustrated in Appendix 1.

Technique

- Following the trauma team's decision to use REBOA, the right groin is prepared with alcoholic chlorhexidine. The overlying pelvic binder may require to be partially cut away.
- The common femoral artery is accessed either percutaneously (either by palpation of pulse or 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 the 180cm or 260cm Amplatz wire introduced. This is performed without fluoroscopic guidance. If resistance is encountered the procedure should be reconsidered. A check x-ray can then be used to confirm the wire is overlying the aortic position in the abdomen (compared to a likely IVC location, or aberrant deflection into a vascular branch).
- For reasons of physical space limitations, we suggest that the wire is turned to the patient's right after about 80 cm of distal course, and placed over the sterile procedure.
trolley, and then supported beyond by a surgical assistant (refer to Setup in the Trauma Resuscitation Bay).

- The needle is then removed, and the dilator and sheath advanced on the wire and into the artery. An approximately 1 cm skin incision will be necessary to facilitate the sheath's entry. The dilator is then removed, leaving the wire and sheath in place.
- The CODA® 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.

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 bifurcation⁴.
• The estimated length of the balloon required may be marked on the balloon with a sterile indelible marker.
• A confirmation plain abdominal x-ray 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 x-ray 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.

Abdominal X Ray 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 CODA 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 100 mL of heparinised saline (1,000 units of heparin in 1 L of saline).
- 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.
Appendix 1 – Equipment

The REBOA Kit

14Fr Sheath with dilator
Amplatz guide wire x2

CODA Balloon
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Version: 2  
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Appendix 2 – Algorithm for the Management of Profound Haemorrhagic Shock Secondary to Uncontrolled Truncal and Extremity Bleeding

*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.
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References


