

REBOA – new snake in the grass?

Does it have a place in South Africa and other LMICs?

Tim Hardcastle – Trauma Surgeon IALCH/UKZN Controversies in Surgery 2016



History – nothing new under the sun (Solomon = Ecclesiates)

Use of an Intra-Aortic Balloon Catheter Tamponade for Controlling Intra-Abdominal Hemorrhage in Man

Lieutenant Colonel Carl W. Hughes (Medical Corps, US Army)

Surgery 1954; 36:65

An intra-aortic balloon catheter tamponade was utilized in two moribund Korean War casualties with uncontrolled intra-abdominal hemorrhage. Although both patients expired, the catheter was effective in temporarily restoring the blood pressure in one case. The catheter should be further evaluated both experimentally and clinically.

No widespread adoption

RESUSCITATIVE THORACOTOMY



So what is REBOA actually?

Resuscitative balloon-occlusion catheter placed via a femoral sheath access to inflate the balloon in the aorta at either level I or III to enable proximal control of non-compressible bleeding in a patient rapidly deteriorating / in cardiac arrest

Resuscitative endovascular balloon occlusion of the aorta*

Zaffer Qasim^{a,*}, Megan Brenner^{a,b}, Jay Menaker^a, Thomas Scalea^a

Resuscitation 96 (2015) 275-279

REBOA presents a markedly less invasive and proactive approach for NCTH in the setting of both refractory shock and traumatic arrest with the potential for improved outcomes.

Greenberg et al. and Malina et al. published early reports of good outcomes following balloon occlusion in the distal descending thoracic aorta for hemorrhage control from ruptured AAA,

Resuscitation 96 (2015) 275-279

Resuscitative endovascular balloon occlusion of the aorta☆ Zaffer Qasim^{a,*}, Megan Brenner^{a,b}, Jay Menaker^a, Thomas Scalea^a

Techniques

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

Adam Stannard, MRCS, Jonathan L. Eliason, MD, and Todd E. Rasmussen, MD

The Journal of TRAUMA® Injury, Infection, and Critical Care • Volume 71, Number 6, December 2011

- 1. Arterial access
- 2. Balloon selection and positioning
- 3. Balloon inflation
- Balloon deflation
- 5. Sheath removal









Indications for REBOA

Non-compressible intraabdominal haemorrhage

Solid organs Major vessel injury

Major pelvic haemorrhage in combination with EPPP

Tamponade Allows imaging in the OR if C-arm / Hybrid suite Resuscitative endovascular balloon occlusion of the aorta for hemorrhage control: Past, present, and future

> J Trauma Acute Care Surg Volume 79, Number 4, Supplement 1

Slava M. Belenkiy, MD, Andriy I. Batchinsky, MD, Todd E. Rasmussen, MD, and Leopoldo C. Cancio, MD, San Antonio, Texas The authors listed the following indications for Zone I REBOA deployment:

- High-grade (Abbreviated Injury Scale [AIS] score ≥ 4) injury to the liver/kidney/spleen
- Mesenteric disruption
- Injury to a named abdominal vessel

Indications for zone III REBOA use were as follows:

- High-grade (AIS score \geq 4) injury to a named pelvic vessel
- Pelvic fracture with ring disruption and/or traumatic amputation at/near a hip

However, REBOA is contraindicated for the treatment of noncompressible hemorrhage in the superior mediastinum, axilla, neck, or face.⁴⁷

Resuscitative endovascular balloon occlusion of the aorta for hemorrhage control: Past, present, and future J Trauma Acute Care Surg Volume 79, Number 4, Supplement 1

Slava M. Belenkiy, MD, Andriy I. Batchinsky, MD, Todd E. Rasmussen, MD, and Leopoldo C. Cancio, MD, San Antonio, Texas

Some caveats:

Most of the research on this is from the last 5 years! Still in evolution in "centres of excellence"

Lots of courses and many "enthusiasts" who have only done this on cadavers or mannicans

Watch the developments closely

Current literature – does it work?

Aortic balloon occlusion is effective in controlling pelvic hemorrhage

Jonathan J. Morrison, MRCS,^{*a,b,c*} Thomas J. Percival, MD,^{*a,b*} Nickolay P. Markov, MD,^{*a,b*} Carole Villamaria, MD,^{*a,b*} Daniel J. Scott, MD,^{*a,b*} Kaylyn A. Saches, BS,^{*a*} Jerry R. Spencer, BS,^{*a*} and Todd E. Rasmussen, MD, FACS^{*a,b,d,**}

Conclusion: Balloon occlusion of the aorta is an effective method to control pelvic arterial hemorrhage. This technique should be further developed as an adjunct to manage noncompressible pelvic hemorrhage.

JOURNAL OF SURGICAL RESEARCH 177 (2012) 341-347

A clinical series of resuscitative endovascular balloon occlusion of the aorta for hemorrhage control and resuscitation

Megan L. Brenner, MD, Laura J. Moore, MD, Joseph J. DuBose, MD, George H. Tyson, MD, Michelle K. McNutt, MD, Rondel P. Albarado, MD, John B. Holcomb, MD, Thomas M. Scalea, MD,



and Todd E. Rasmussen, MD

2013;75: 506-511.

J Trauma Acute Care Surg Volume 75, Number 3

TABLE 1. Demographics and Summary of REBOA Use in Six Patients											
Patient		1	2	3	4	5	6				
Age, y		62	24	59	25	40	27				
Sex		Male	Male	Male	Male	Male	Female				
Mechanism injury	of	MVC	GSW	GSW	MVC	MCC	ATV collision				
Injury Severity Score (ISS)		28	50	9	25	48	43				

Score (ISS)							
A C ^{SBP before} REBOA, mm Hg	70	70	0	60	70	85	ion
Cardiac arrest before REBOA	No	No	Yes	No	No	No	
SBP after] REBOA, mm Hg	135	122	100	110	130	125	
MicAdmission base deficit	12	4	NA	16	14	19	MD,
Time to occlusion, min	5	4	4	6	6	6	irg
Time of occlusion, min	12	16	70	60	65	36	r 3
Surgery after REBOA	No	Yes	Yes	Yes	Yes	Yes	
Pelvic embolization after REBOA	Yes	Yes	No	No	Yes	Yes	
Complication of REBOA	No	No	No	No	No	No	
Outcome	Alive	Alive	Alive	Alive	Brain death	Death (care withdrawn)	

ATV, all-terrain vehicle; GSW, gunshot wound; MCC, motorcycle collision; MVC, motor vehicle collision; NA, not applicable.

Current literature – complications/outcome



The Role of Intra-aortic Balloon Occlusion in Penetrating Abdominal Trauma

BHUPENDRA K. GUPTA, M.D., SATISH C. KHANEJA, M.D., LUCIO FLORES, M.D., LEWIS EASTLICK, M.D., WAYNE LONGMORE, M.D., AND GERALD W. SHAFTAN, M.D.

Complication Three serious complications plated to the use of IABO were noted in this group of 21 patients. One patient (#5, Table III), who had multiple attempts at the percutaneous placement of the balloon catheter in the Emergency Department continued to have an ischemic right lower extremity, despite a thrombectomy of the iliofemoral artery which was done 6 hours after initial celiotomy. The catheter exited through the aortic injury in two patients. In the first patient IABO was attempted before celiotomy and aortic exit was recognized by the disappearance of the central aortic pressure tracing in the catheter and a lack of resistance in inflating the balloon; this patient underwent thoracotomy for aortic cross clamping. In the second case, aortic

exit occurred during the placement at celiotomy and the catheter was redirected. In the 11 patients in whom a neurologic assessment could be made, there was no instance of spinal cord damage.

In a multicenter cooperative trial involving four different hospitals, there were eight complications in 23 patients. Complications consisted of one instance of paraplegia when there was prolonged balloon inflation time, four instances of the catheter exiting from aortic injuries, and three instances of femoral artery thrombosis. Our initial 14 patients and the three complications formed a part of this trial.

Current literature – complications: Japan Evaluation of the safety and feasibility of resuscitative endovascular balloon occlusion of the aorta

With regard to systemic complications, there were nine cases of AKI. Only one case had AKI alone. Five of nine cases had an AKI grade of failure according to the RIFLE criteria. There were also nine cases of MOF (Table 2). Complications of the lower extremities associated with vascular puncture were observed in three cases, lower limb ischemia in two and external iliac artery injury in one, all of which required lower limb amputation.

Nobuyuki Saito, MD, Hisashi Matsumoto, MD, PhD, Takanori Yagi, MD, Yoshiaki Hara, MD, Kazuyuki Hayashida, MD, Tomokazu Motomura, MD, Kazuki Mashiko, MD, Hiroaki Iida, MD, Hiroyuki Yokota, MD, PhD, and Yukiko Wagatsuma, MD, MPH, DrPH, Inzai, Japan

J Trauma Acute Care Surg. 2015;78: 897–904.

Current literature – outcome USA

Implementation of resuscitative endovascular balloon occlusion of the aorta as an alternative to resuscitative thoracotomy for noncompressible truncal hemorrhage

J Trauma Acute Care Surg Volume 79, Number 4

Laura J. Moore, MD, Megan Brenner, MD, Rosemary A. Kozar, MD, PhD, Jason Pasley, DO, Charles E. Wade, PhD, Mary S. Baraniuk, PhD, Thomas Scalea, MD, and John B. Holcomb, MD, Houston, Texas

REBOA groups, there were a significantly higher number of deaths in the emergency department among the RT patients as compared with the REBOA patients (62.5% vs. 16.7%, p < 0.001). REBOA had fewer early deaths and improved overall survival as compared with RT (37.5% vs. 9.7%, p = 0.003).

REBOA is feasible and controls noncompressible truncal hemorrhage in trauma patients in profound shock. Patients undergoing REBOA have improved overall survival and fewer early deaths as compared with patients undergoing RT. (*J Trauma Acute Care Surg.* 2015;79: 523–532. Copyright © 2015 Wolters Kluwer Health, Inc. All rights reserved.)

Current literature – outcomes Japan

Of 45,153 patients who met inclusion, 452 patients (1.0%) received REBOA placement. These patients were seriously injured (median Injury Severity Score [ISS], 35) and had high mortality (76%). Patients who did not receive a REBOA had significantly lower injury severity (median ISS, 13; p < 0.0001) and lower mortality (16%). After matching REBOA patients with controls with similar PSs for treatment, the crude conditional odds ratio of survival by REBOA treatment was 0.30 (95% confidence interval, 0.23–0.40).

Tatsuya Norii, MD, Cameron Crandall, MD, and Yusuke Terasaka, MD, Albuquerque, New Mexico

Survival of severe blunt trauma patients treated with resuscitative endovascular balloon occlusion of the aorta compared with propensity score-adjusted untreated patients J Trauma Acute Care Surg Volume 78, Number 4 2015;78: 721–728.



30-day Survival to Discharge, by Treatment Group

Tatsuya Norii, MD, Cameron Crandall, MD, and Yusuke Terasaka, MD, Albuquerque, New Mexico

Survival of severe blunt trauma patients treated with resuscitative endovascular balloon occlusion of the aorta compared with propensity score-adjusted untreated patients J Trauma Acute Care Surg Volume 78, Number 4 2015;78: 721–728.

From the ED to the OR to the Field?

Is this a new prehospital option? FEASIBLE TRAINABLE DO-ABLE

Scotland's

physician-led, pre-hospital services, particularly ones combined under the umbrella of ScotSTAR (Scottish Specialist Transport and Retrieval), would be ideal platforms from which to deliver such an adjunct.



Resuscitative endovascular balloon occlusion of the aorta (REBOA): A bridge to definitive haemorrhage control for trauma patients in Scotland? THE SURGEON 12 (2014) 119-120 Andersen et al. Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine 2014, 22(Suppl 1):P19 http://www.sjtrem.com/content/22/S1/P19

Pre-hospital resuscitative endovascular balloon occlusion of the aorta

Nina Gjerde Andersen^{1*}, Marius Rehn^{1,2,3}, Marianne Oropeza-Moe⁴, Nils Petter Oveland^{3,5}

Results

The mean time from arrival to inflation of the balloon was <u>4 minutes and 19 seconds</u> (SD \pm 58 seconds) and from skin contact to inflation 3 minutes and 12 seconds (SD \pm 42 seconds). There was a clinical significant increase in SBP and DBP after balloon inflation (Figure 1).

through the femoral artery and into the aorta using an ultrasound guided Seldinger-technique, and inflated and deflated after each bleeding step. The systolic (SBP) and diastolic (DBP) blood pressures were measured.

The balloon was inserted

Conclusion

REBOA could stop pelvic bleedings and improve central perfusion during massive bleeding. The technique appears feasible in the pre-hospital environment with an insertion time approximating 3 minutes after training. To treat the right patients at the right time requires additional decision-making skills for pre-hospital crews.

Field REBOA

To date:

1 case report!



What about SA and the other LMIC's?

Immature systems staffed by non-specialist practitioners *Time to definitive care must be under 40 minutes for survival* Limited specialists

Limited access to fluoroscopy (newer devices don't need this)

Minimal prehospital physician-staffed vehicles or helicopters

Other medical priorities – with the devil of distance

Not for the immediate future outside clinical trials and in-hospital

Evidence to qualify this opinion?

Resuscitative endovascular balloon occlusion of the aorta (REBOA): a population based gap analysis of trauma patients in England and Wales.

<400 pts out of 73000 would benefit!

1 patient very 46-95 days in MTC's

High mortality group

From LMIC perspective – not priority

Barnard et al. Emerg Med J. 2015 Dec;32(12):926-32. Considerations prior to doing this

Availability of resources (OR, equipment)

Distance from definitive care

Average time to major trauma centre in KZN 8 hours!*

Skill set – can we allow interns or CMO's to do this?

Complication profile (RT vs REBOA)

Time & training

*Cheddie et al, SAMJ, 2011; 101: 176

Considerations prior to doing this

Availability of resources (OR, equipment)

Distance from definitive care

Skill set

Complication profile (RT vs REBOA)

Time & training

Manual pressure or the resuscitative endovascular balloon occlusion of the aorta techniques have demonstrated clinical effectiveness for the control of major vessel bleeding, although complications need to be carefully considered before advocating clinical use. At present, fast transfer to the trauma center remains paramount.

Traumatic intra-abdominal hemorrhage control: J Trauma Acute Care Surg Has current technology tipped the balance toward a role for prehospital intervention? J Trauma Acute Care Surg Volume 78, Number 1 153–163. Muzzafer Chaudery, MRCS, James Clark, MRCS, Mark H. Wilson, FRCS, Duncan Bew, FRCS,

Guang-Zhong Yang, PhD, and Ara Darzi, FRS, London, United Kingdom

A systematic review of the use of resuscitative endovascular balloon occlusion of the aorta in the management of hemorrhagic shock.

Overall, the evidence base is weak with no clear reduction in hemorrhage-related mortality demonstrated. Formal, prospective study is warranted to clarify the role of this adjunct in torso hemorrhage.

Morrison JJ1, Galgon RE, Jansen JO, Cannon JW, Rasmussen TE, Eliason JL.

J Trauma Acute Care Surg. 2016 Feb;80(2):324-34

AORTA Trial

114 patients

46 REBOA vs. 68 RT

Equal time to aortic occlusion with both techniques (~12 minutes)

Overall survival 21% - no difference between the two techniques

No significant difference as to overall survival between groups- ?sample-size factor

28 vs 16% survival, but:

-OPEN >>> penetrating trauma; >>>CPR in progress; >>>hypotension; >>> survivors to ICU admission

-REBOA >>>Deaths in ED/OR

Journal of Trauma and Acute Care Surgery, Publish Ahead of Print DOI: 10.1097/TA.0000000000001079

Where are we today? More questions!

- 1. Is there a role for REBOA in the setting of thoracic trauma?
- 2. If thoracic injury can be excluded with reasonable certainty, should REBOA replace RT in the setting of blunt trauma arrest?
- 3. How does REBOA compare with RT for the patient in extremis with abdominal trauma?
- 4. How does REBOA compare with RT for the patient in extremis with pelvic trauma?
- 5. Does REBOA offer benefit in a patient with severe shock (SBP, 60–80 mm Hg) after abdominal trauma or should LAP be undertaken without delay?
- 6. Does REBOA offer benefit in a patient with severe shock (SBP, 60–80 mm Hg) after pelvic trauma or should pelvic packing/external fixation/angioembolization be undertaken without delay?
- 7. Do new low-profile devices offer significant advantages in terms of improving the risk-benefit profile of REBOA, allowing more rapid deployment and potentially fewer vascular complications?

8. Who should be performing REBOA? What should be the standards for training, credentialing, and competency?

The role of REBOA in the control of exsanguinating torso hemorrhage

Walter L. Biffl, MD, Charles J. Fox, MD, and Ernest E. Moore, MD, Denver, Colorado

J Trauma Acute Care Surg Volume 78, Number 5

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Summary



At least for now outside the big centres of excellence

No entry