

## Paramedic Critically Appraised Topic

**Title:** Does prehospital Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) improve patient outcomes in civilian populations?

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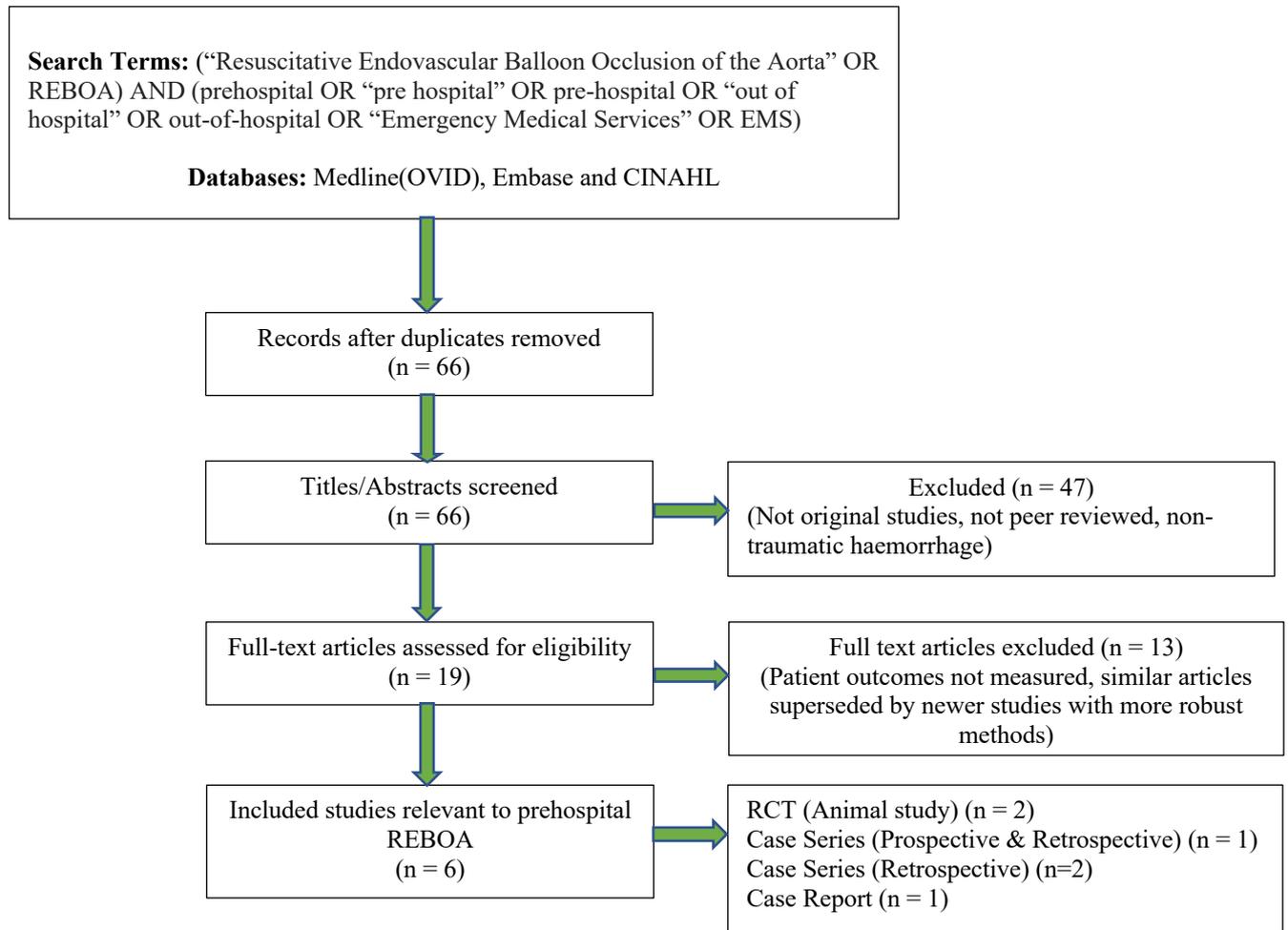
**Word Count:** 1302

**Clinical Scenario:** Paramedics respond to a 24 year old male who has been thrown from his motorbike following a motorway collision. The patient is conscious but unstable, haemorrhaging from his right leg which has been partially amputated at the proximal femur. The patient's pelvis is also unstable. He does not appear to have sustained any significant injuries to his head or chest.

**PICO:** In civilian patients with subdiaphragmatic, non-compressible haemorrhage, does prehospital use of REBOA improve outcomes?

**Search Rationale:** Prehospital use of REBOA was first described in abdominal trauma casualties of the Korean War. Since then, REBOA has largely been overshadowed by a preference for resuscitative thoracotomy (RT) with aortic clamping. The evolution of endovascular technology in the past decades, however, has seen REBOA rise in popularity as a minimally invasive alternative to RT for patients with subdiaphragmatic non-compressible haemorrhage. Given the recent return and rising promise of REBOA as a critical, lifesaving intervention, a search will be performed to understand its modern application and outcomes in the prehospital civilian setting.

## Search Strategy:



Authors and Year	Study Design	Population	Study Aims	Results	Strengths and Limitations
White et al., (2011)	Randomised Controlled Trial (Animal Study)	Swine (n = 18)	To compare the haemodynamic and physiologic benefits of REBOA compared to Resuscitative Thoracotomy with Aortic Clamp (RT) in class IV haemorrhagic shock.	REBOA recipients were less acidotic and required less fluid and norepinephrine in resuscitation than the RTAC group.	(+) Strong study design  (+) Compares outcomes of REBOA to outcomes of currently accepted best practice intervention, as well as control group.  (-) Animal study - reduces transferability of evidence to humans  (-) 8 year old study; improvements/changes in

					REBOA intervention have been made since  (-) Small sample size
Kuckleman et al., (2018)	Randomised Controlled Trial (Animal Study)	Swine  (n= 28)	To compare levels of survival and reperfusion injury between intermittent and full occlusion REBOA in class IV haemorrhagic shock.	Intermittent REBOA produced longer survival times, decreased acidosis, and lowered resuscitation requirements compared to full REBOA group and to nil intervention group.	(+) Strong study design  (-) Animal study - reduces transferability of evidence to humans  (-) Artificially sustained, isolated vascular injury- not representative of true spectrum of traumatic non-compressible injury.  (-) Limited period of post-injury resuscitation and observation - does not capture potential long-term adverse effects on morbidity and mortality.
Brenner et al., (2018).	Case Series (Prospective and Retrospective)	AAST AORTA registry patients (without penetrating thoracic injury) undergoing aortic occlusion via Aortic Clamp or Zone 1 REBOA.  (n = 285)	To investigate and compare the use and outcomes of REBOA (Zone 1 only) and Resuscitative Thoracotomy with Aortic Clamping (RT) performed in the Emergency Department (ED) for patients with haemorrhagic shock.	Overall survival beyond ED (REBOA 63%, RT 44%)  Overall survival to discharge (REBOA 9.6%, RT 2.5%)  In patients not requiring CPR before intervention:  Survival beyond ED (REBOA 93%, RT 48%)  Survival to discharge (REBOA 22.2%, RT 3.4%)	(+) Multi-centre study (8 Level 1 Trauma centres)  (+) Procedure performed in emergency setting outside of operating theatre  (+) Utilised prospective data which allowed adjustment for variables to be performed more accurately.  (-) Differences between institution's policies may have influenced intervention selection  (-) Procedure not performed prehospitally so reduced transferability to this setting  (-) Specific to non-penetrating injuries and Zone 1 REBOA only. Other subsets not accounted for.  (-) Only mortality measured, morbidity overlooked

<p>Matsumura et al., (2018)</p>	<p>Case Series (Retrospective)</p>	<p>DIRECT-IABO registry patients with traumatic refractory haemorrhagic shock  (n = 109)</p>	<p>To investigate the difference in survival outcomes between early and delayed REBOA recipients in ED.</p>	<p>Early arterial access for REBOA is significantly associated with better survival outcomes.</p>	<p>(+) Multi-centre study (23 hospitals)</p> <p>(+) Long study period (5 years)</p> <p>(+) Logistic regression analysis used to adjust for selection bias and other confounders</p> <p>(+) Kaplan-Meier analysis used to strengthen survival data</p> <p>(+) Low risk of Bias</p> <p>(+) Procedure performed in emergency setting outside of operating theatre</p> <p>(-) Procedure not performed prehospitally so reduced transferability to this setting</p> <p>(-) Japanese model has a lot of differences to western trauma models e.g. REBOA placed in Zone 1 regardless of injury site and intervention performed by ED doctors, not surgical doctors</p> <p>(-) Retrospective study design</p>
<p>Northern et al., (2018)</p>	<p>Case Series (Retrospective)</p>	<p>Combat casualties with non-compressible torso haemorrhage  (n = 20)</p>	<p>To trace the utility of REBOA in the austere environment</p>	<p>All patients were stabilised with REBOA and whole blood and survived to transfer.</p>	<p>(+) largest study of REBOA use on severely injured out-of-hospital casualties</p> <p>(-) Military study - reduces transferability of evidence to civilian setting</p> <p>(-) Long-term patient outcomes not measured</p>

					(-) Retrospective study design
Sadek et al., (2016)	Case Report	First civilian patient to undergo REBOA prehospitally  (n = 1)	To describe the first case of REBOA in the prehospital civilian population (One of only two published case reports in this setting).	Patient was discharged at 52 days neurologically intact and made a complete recovery.	(+) Highly relevant: REBOA performed in prehospital civilian trauma setting  (-) Descriptive design  (-) Single Case, single patient

*Abbreviations:* AAST AORTA; American Association for the Surgery of Trauma's Aortic Occlusions in Resuscitation for Trauma and Acute Care Surgery, EMS; Emergency Medical Services, RT; Resuscitative Thoracotomy, ED; Emergency Department, AC (Aortic Clamp), DIRECT-IABO; Diagnostic Interventional Radiology in Emergency, Critical care and Trauma- Intra-Aortic Balloon Occlusion.

**Comments:** In patients with non-compressible torso injury, the use of REBOA appears to be associated with improved patient outcomes when compared to the current prehospital practices of haemorrhage control. Related studies have demonstrated increased survival rates and less physiological disturbance, even when compared to advanced surgical interventions such as resuscitative thoracotomy with aortic clamping. The articles critiqued above represent the various settings in which REBOA research has taken place. The majority of data is made available from animal trials, trauma centre registries, and combat casualties. These can be used to help predict the utility prehospital REBOA, however substantially more research specific to the prehospital civilian setting needs to be undertaken to form an evidence base. To date, there are only two published case reports of REBOA performed in the field by paramedic/physician response teams, one in London and one in Paris. Both were successful in stabilising the patient for transport to definitive care. These studies and reports show early promise for the continued development of REBOA in prehospital practise.

**Consider:** Emergency Medicine bodies have not reached consensus on appropriate indications for REBOA, zone placement, and occlusion pressures and timeframes, either in or out of hospital. Future research must incorporate these important variables to determine their influence on patient outcomes.

**Clinical Bottom Line:** The current body of literature regarding prehospital civilian use of REBOA is weak, requiring reliance on literature from animal trials, trauma centres and combat settings to predict successes. In the absence of quality research, EMS agencies looking to incorporate REBOA into their practise, should do so with caution, and must ensure they are resourced with appropriately trained physicians.

## References

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