

Practice Preferences using Resuscitative Endovascular Balloon Occlusion of the Aorta for Traumatic Injury Before and After the 2017 EndoVascular and Hybrid Trauma and Bleeding Management Symposium

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Background: Resuscitative endovascular balloon occlusion of the aorta (REBOA) is a technique to aid in resuscitative efforts for hemorrhagic shock. The use of REBOA is not yet commonplace and there is little understanding of real-world practice patterns. The Endovascular and Hybrid Trauma and Bleeding Management Symposium is a large international conference specifically developed to discuss multidisciplinary, endovascular and hybrid approaches to hemorrhage management. We sought to evaluate provider opinions and practice patterns using REBOA for traumatic vascular injury before and after attending this conference.

Methods: A detailed survey was completed by a variety of providers before and after the conference. The survey was composed of demographic information, and focused on practice patterns and opinions regarding the implementation of REBOA.

Results: We received 186 survey responses (99 pre, 87 post). There was increased perception of feasibility for REBOA in all settings, with the largest increase for pre-hospital and austere military environments (53.5% pre, 67.8% post and 59.6% pre, 73.6% post respectively). While there was no consensus on tolerable occlusion times and indications for utilization, most participants felt that partial REBOA was the most viable technique for prolonging the benefits of REBOA, and more participants came to this conclusion after attending the conference (62.2% pre, 81.6% post, $p = 0.006$).

Conclusions: REBOA is an exciting and important advancement in the management of life threatening hemorrhage; however, its implementation has not been codified and there is much variation in practitioners' understanding of its use. Continued investigation is needed to determine the appropriate indications, methods, and practical limitations of REBOA as a new hemorrhage management paradigm.

Keywords: Trauma; Endovascular; REBOA; Practice Patterns

Received: 8 June 2017; Accepted: 23 July 2017

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Author contributions: JJB was responsible for the conception and design. ED and ML drafted the manuscript. ED, ML, AJD, ERF, RMR, MAS, and JJB were involved in critical revision of the manuscript. ED has responsibility for the content.

Conflicts of interest: None.

Funding: None.

Disclosure: The views expressed in this material are those of the authors, and do not reflect the official policy or position of the US Government, the Department of Defense, the Department of the Air Force or the University of California.

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INTRODUCTION

Resuscitative endovascular balloon occlusion of the aorta (REBOA) is a technique to aid in resuscitative efforts for hemorrhagic shock [1–6]. Aortic occlusion balloon placement has a role in both elective and emergency surgery, including with management of placenta accreta [7–11], as a technique to decrease blood loss during orthopedic or pelvic tumor excisions [12–16], and for traumatic injuries [1,17–20]. Successful use has been reported in the prehospital setting both in austere military [17], and civilian environments [18]. Though the use of this technique has been increasing, it is not yet common practice and there has been controversy with regard to ideal settings and indications. Additionally, there is little understanding of real-world practice patterns and attitudes toward REBOA.

The EndoVascular and Hybrid Trauma and Bleeding Management (EVTM) Symposium is an international conference specifically developed to discuss multidisciplinary, endovascular and hybrid approaches to hemorrhage management, including techniques such as REBOA. World-renown experts in REBOA discuss indications and techniques for its use drawing from current literature and practical experience. Future directions for REBOA, emerging resuscitative techniques, and technological innovations for hemorrhage control are considered. The conference is attended by a wide range of specialties including trauma and vascular surgeons, anesthesiologists, emergency medicine physicians and interventional radiologists.

We sought to evaluate provider opinions and practice patterns using REBOA for control of hemorrhage due to trauma before and after attending the EVTM conference. Additionally, we aimed to characterize areas of consensus for the future development of practice guidelines and elucidate topics of significant discordance. Furthermore, we hypothesized that after hearing expert presentations on this technique, more providers would accept the multidisciplinary use of REBOA to manage bleeding caused by traumatic injuries.

METHODS

A survey was distributed via email to registered participants before and after the inaugural EVTM Symposium in Orebro, Sweden which ran from February 2nd to February 4th, 2017. The survey was accessible online via Survey Monkey[®] and consisted of 18 identical multiple-choice questions for the pre- and post-conference surveys and an additional four agree/disagree questions for the post-conference survey (Appendix). Both pre- and post-attendance surveys contained questions regarding demographics (specialty, location and years in clinical practice), practice patterns, and the technique of REBOA. The post-conference survey included four additional questions regarding potential contraindications

for REBOA, provider training, and scope of practice. Responses were collected by Survey Monkey[®] and entered into Microsoft[®] Excel[®] spreadsheets for tabulation and analysis. As emergency medicine physicians and trauma surgeons are most likely to be the initial provider for a patient with traumatic hemorrhage, a subset analysis of their selection of providers qualified to perform REBOA was completed. Statistical analysis was performed using Microsoft[®] Excel[®] and the chi-square test calculator available at Vassarstats.net. Fisher's exact probability test was used for instances where expected cell frequencies were less than 5. Otherwise, Pearson's *p*-value was used and significance was set at *p* < 0.05.

RESULTS

Participant Demographics

Participant demographics are described in Table 1. There were approximately 350 conference attendees. We received a total of 186 survey responses, 99 pre-conference and 87 post-conference for a response rate of 28.3% and 24.9%, respectively. The majority of participants were vascular surgeons (28.3% pre, 27.6% post), trauma surgeons (32.3% pre, 28.7% post) and emergency medicine physicians (17.2% pre, 12.6% post). Europe was the most represented region (61.9% pre, 72.4% post) followed by North America (16.5% pre, 12.6% post) and Asia (17.5% pre, 9.2% post). Most participants were in practice 0–10 years (44.9% pre, 45.9% post). A quarter were in practice longer than 15 years (27.6% pre, 22.4% post) and approximately 15% were trainees. There was no significant difference between the pre- and post-conference groups in specialty (*p* = 0.68), region of practice (*p* = 0.24), and years of training (*p* = 0.85).

Which Specialty Should Perform REBOA?

Participants were asked which specialties should optimally perform REBOA for trauma victims. On subset analysis of emergency physicians and trauma surgeons, before the conference, providers most often selected their own specialty as the specialty that should be primarily responsible for the use of endovascular trauma management principles (58.8% of emergency physicians chose emergency physicians; 90.6% of trauma surgeons chose trauma surgeons). After the conference trauma surgeons increased their selection of multidisciplinary teams (31.3% pre, 60.0% post, *p* = 0.03) and emergency medicine physicians trended toward the same (52.9% pre, 81.8% post, *p* = 0.23).

There was an overall willingness by emergency physicians and trauma surgeons to accept REBOA performed by "any provider with appropriate training" regardless of specialty (emergency physician 82.4% pre, 90.9% post, *p* = 0.64; trauma surgeon 43.8% pre,

Table 1 Demographics of respondents for surveys sent before and after the EVT conference.

	Pre-Conference	Post-Conference	p
Specialty	<i>n</i> = 99 (%)	<i>n</i> = 87 (%)	
Vascular Surgeon	28 (28.3)	24 (27.6)	0.92
Trauma Surgeon	32 (32.3)	25 (28.7)	0.60
Interventional Radiologist	8 (8.1)	11 (12.6)	0.31
Emergency Physician	17 (17.2)	11 (12.6)	0.39
Other	14 (14.1)	16 (18.4)	0.43
Region of Practice	<i>n</i> = 97 (%)	<i>n</i> = 87 (%)	
Europe	60 (61.9)	63 (72.4)	0.13
United Kingdom	3 (3.1)	3 (3.5)	1.00
North American	16 (16.5)	11 (12.6)	0.46
South America	1 (1.0)	0 (0)	1.00
Asia	17 (17.5)	8 (9.2)	0.10
Africa	0 (0)	2 (2.3)	0.22
Years in Practice	<i>n</i> = 98 (%)	<i>n</i> = 85 (%)	
In training	15 (15.3)	13 (15.3)	1.00
0–5 years	23 (23.5)	18 (21.2)	0.71
6–10 years	21 (21.4)	21 (24.7)	0.60
11–15 years	12 (12.2)	14 (16.5)	0.41
>15 years	27 (27.6)	19 (22.4)	0.42

56.0% post, $p = 0.36$). (Table 2). The vast majority of post-conference participants (93.1%) agreed that REBOA can be safely and effectively performed in a variety of settings and by providers of various clinical backgrounds provided that they have appropriate training and local protocols for use.

REBOA Indications and Placement

In general, REBOA was widely accepted for non-compressible torso and junctional hemorrhage due to both blunt and penetrating trauma, with a slightly decreased confidence in its use in austere military environments (Table 3). After the conference, there was increased perception for feasibility in all settings, with the largest increase found for the prehospital and austere military environments (53.5% pre, 67.8% post, $p = 0.047$ and 59.6% pre, 73.6% post, $p = 0.045$, respectively).

Prior to the conference, 62.9% of providers favored common femoral artery access in anticipation of REBOA in every hypotensive trauma victim with a systolic blood pressure (SBP) less than 90 mmHg. After the conference, only 54% of providers favored this broad indication for early femoral access ($p = 0.22$). After the conference, more providers tended to support arterial cannulation prior to the onset of hypotension in patients with findings such as severe pelvic fractures and ultrasound demonstrating free abdominal fluid (53.6% pre, 65.5% post, $p = 0.10$). There was almost unanimous agreement (97% pre, 98.9% post, $p = 0.62$) that femoral access is appropriate in the emergency department. Following the conference, more providers tended to accept that femoral access is appropriate in the prehospital setting

as well (51.5% pre, 62.1% post, $p = 0.15$). Most participants indicated that external landmarks were adequate to confirm balloon location prior to inflation (60.2% pre, 60.9% post, $p = 0.92$).

When comparing REBOA to emergent resuscitative (ER) thoracotomy, approximately one-quarter of participants said the indications for both are the same. Over half of respondents preferred to choose between these modalities on a case-by-case basis.

Contraindications for REBOA

For both blunt and penetrating trauma, most providers felt that bleeding in the neck and bleeding in the chest were contraindications for REBOA. Associated head injury was also identified as a common contraindication. After the conference, clinical suspicion for traumatic brain injury (TBI) was identified as a contraindication to REBOA by 50.6% of providers, whereas 64.4% of providers felt that occult TBI on imaging should contraindicate REBOA use. In general, post-conference, more participants felt that these injuries were contraindications compared to pre-conference results (Table 3).

REBOA Techniques

We investigated the perceived maximum inflation time for both Zone 1 (distal to left subclavian, proximal to celiac axis) and Zone 3 (distal to renal arteries, proximal to aortic bifurcation). Most participants would not recommend Zone 1 occlusion for longer than an hour (53.6% pre, 50.0% post, $p = 0.62$), with a third of those surveyed recommending that Zone 1 occlusion be

Table 2 Emergency physician and trauma surgeon preferences regarding specialty responsible for endovascular trauma management and deployment of REBOA balloon catheters pre- and post-conference.

What specialty should...	Emergency Physicians		Trauma Surgeons	
	Pre n = 17 (%)	Post n = 11 (%)	Pre n = 32 (%)	Post n = 25 (%)
... primarily be responsible for endovascular trauma management for trauma patients?				
Vascular Surgeons	3 (17.6)	2 (18.2)	17 (53.1)	10 (40.0)
Trauma Surgeons	7 (41.2)	4 (36.4)	28 (90.6)*	14 (56.0)*
Interventional Radiologists	7 (41.2)	2 (18.2)	13 (40.6)	6 (24.0)
Emergency Physicians	10 (58.8)	4 (36.4)	6 (18.8)	5 (20.0)
Multidisciplinary team composed of the above	9 (52.9)	9 (81.8)	10 (31.3)**	15 (60.0)**
... optimally be performing REBOA for trauma victims?				
Vascular Surgeons	6 (35.3)	4 (36.4)	19 (59.4)	15 (60.0)
Trauma Surgeons	7 (41.2)	5 (45.5)	16 (50.0)	13 (52.0)
Interventional Radiologists	7 (41.2)	4 (36.4)	25 (78.1)	15 (60.0)
Emergency Physicians	10 (58.8)	5 (45.5)	6 (18.8)	8 (32.0)
Any appropriately trained provider	14 (82.4)	10 (90.9)	14 (43.8)	14 (56.0)

* $p = 0.007$, ** $p = 0.03$.

limited to 30 minutes or less. As Zone 3 occlusion may confer less ischemic insult than Zone 1 occlusion, more participants were willing to leave a balloon inflated for 60 minutes or more (46.4% pre, 55.8% post, $p = 0.24$ Zone 3 versus 21.6% pre, 36.0% post, $p = 0.031$ Zone 1) In continuously unstable patients, some providers were willing to maintain occlusion without a defined time limit as needed to maintain hemorrhage control (16.5% pre, 18.6% post, $p = 0.71$ Zone 1 versus 30.9% pre, 36.8% post, $p = 0.40$ Zone 3). However, nearly a third of respondents felt that there is still too little data available to determine a maximum occlusion time for either zone.

We investigated the most promising modality to extend REBOA times without incurring undue distal ischemic injury allowing participants to choose between intermittent REBOA (releasing the balloon completely for short durations to allow distal perfusion before reinflating completely) and early partial REBOA (transitioning to partial occlusion after a short period of full occlusion, but not letting the balloon down all the way or reinflating completely). By far participants favored partial REBOA over intermittent REBOA for reducing distal ischemia during balloon occlusion, a conclusion more people reached after attending the conference (62.2% pre, 81.6% post, $p = 0.004$) (Table 4).

DISCUSSION

Despite the increasing popularity of REBOA, there has been difficulty identifying consensus criteria for its implementation. We sought to assess provider preferences regarding management and use of REBOA in trauma patients, and analyze the effect of attendance at the EVTSM symposium on those beliefs.

Consensus from this survey demonstrated that REBOA may be indicated for bleeding due to blunt and

penetrating trauma, even in an austere setting. The majority found REBOA to be most feasible in the emergency department and in the operating room. More than half felt REBOA was feasible in the prehospital environment or austere military environments. Most felt that early femoral access should be obtained in patients who are hypotensive and transiently or not responding to fluid/blood administration, and that it was appropriate to obtain arterial access in the emergency room. Most providers felt that endovascular management of traumatic injuries should be multidisciplinary, and many felt that REBOA could be performed by any appropriately trained medical provider.

We lack consensus on the use of REBOA in patients with concomitant TBI. Animal data have demonstrated a significant increase in intracranial pressure during occlusion, and case reports have documented worsening cerebral hemorrhage following REBOA [21–22]. Opinions regarding the use of REBOA in a polytrauma patient with TBI is mixed, with half of the providers identifying TBI as a contraindication for REBOA use.

There was also no clear consensus for maximum inflation times for REBOA in Zone 1 or 3, and a third of participants found the data insufficient to provide a recommendation. Partial REBOA is a strong advance in this technology, focused on extending the benefits of REBOA, and most participants felt that this will be the most viable technique for prolonging REBOA time. This was also one of the only areas of significant change in opinion during the EVTSM symposium with intermittent REBOA falling out of favor on post-conference surveys. Ongoing research on partial REBOA and development of new occlusion catheters holds the promise of making this technique both practical and commonplace [23–26].

Based on this survey data, we have identified some consensus patterns in the use of REBOA. This study is limited in that it does not necessarily include providers

Table 3 Indications, contraindications and deployment of REBOA selected by participants before and after EVTm conference.

	Pre-Conference	Post-Conference	p
*REBOA indicated for bleeding due to:	n = 98 (%)	n = 87 (%)	
Blunt trauma	88 (89.8)	79 (90.8)	0.82
Penetrating trauma	88 (89.8)	75 (86.2)	0.45
Combat injury in austere setting	69 (70.4)	71 (81.6)	0.08
*REBOA feasible in the:	n = 99 (%)	n = 87 (%)	
Prehospital environment	53 (53.5)	59 (67.8)	0.047
Emergency department	91 (91.9)	84 (96.6)	0.18
Operating room	84 (84.9)	79 (90.8)	0.22
Intensive care unit	49 (49.5)	46 (52.9)	0.65
Austere military environment	59 (59.6)	64 (73.6)	0.045
*Early femoral artery access should be obtained in:	n = 97 (%)	n = 87 (%)	
Patients in extremis (no pulse, no BP)	37 (38.1)	31 (35.6)	0.73
Every trauma victim with SBP < 90 mmHg	61 (62.9)	47 (54.0)	0.22
SBP >90 mmHg with suspicious injury (pelvic fx, + FAST)	52 (53.6)	57 (65.5)	0.10
SBP <90 mmHg unresponsive to fluid/blood administration	80 (82.5)	70 (80.5)	0.73
SBP <90 mmHg transiently responsive to fluid/blood	65 (67.0)	64 (73.6)	0.33
*Femoral access is appropriate in the:	n = 99 (%)	n = 87 (%)	
Prehospital environment	51 (51.5)	54 (62.1)	0.15
Emergency department	96 (97.0)	86 (98.9)	0.62
Interventional suite	75 (75.8)	71 (81.6)	0.33
Operating room/hybrid suite	88 (88.9)	78 (89.7)	0.86
Intensive care unit	60 (60.6)	54 (62.1)	0.84
*Confirmation of REBOA balloon location prior to inflation:	n = 98 (%)	n = 87 (%)	
External landmarks only	59 (60.2)	53 (60.9)	0.92
Standard predetermined distances	34 (34.7)	26 (29.9)	0.48
Plain radiography	40 (40.8)	31 (35.6)	0.47
Fluoroscopy	31 (31.6)	32 (36.8)	0.46
Ultrasound	36 (36.7)	37 (42.5)	0.42
Computed tomography	5 (5.1)	4 (4.6)	1.00
Indications for ER thoracotomy vs REBOA	n = 99 (%)	n = 86 (%)	
Indications are largely identical	27 (27.3)	22 (25.6)	0.79
Indications are completely different	10 (10.1)	4 (4.7)	0.16
Decision should be individualized to each case	57 (57.6)	59 (68.6)	0.12
Insufficient data on REBOA for me to comment at this time	23 (23.2)	13 (15.1)	0.16
*Contraindications to REBOA in blunt trauma	n = 85 (%)	n = 82 (%)	
Bleeding in the neck	61 (71.8)	74 (90.2)	0.002
Bleeding in the chest	55 (64.7)	54 (65.9)	0.89
Bleeding in the abdomen or pelvis	3 (4.1)	1 (1.2)	0.62
Long bone fractures of extremities	4 (4.7)	6 (7.3)	0.53
Associated intracranial injury and/or bleeding	40 (47.1)	38 (46.3)	0.92
*Contraindications to REBOA in penetrating trauma	n = 84 (%)	n = 82 (%)	
Penetrating neck injury	65 (77.4)	70 (85.4)	0.19
Penetrating chest injury	52 (61.9)	59 (72.0)	0.17
Penetrating abdominal injury	5 (6.0)	2 (2.4)	0.44
Penetrating extremity injury with significant bleeding	9 (10.7)	7 (8.5)	0.63
Associated head injury	33 (39.3)	40 (48.8)	0.22

*indicates multiple answers possible per participant.

who are actively using REBOA, and therefore only reflects the opinions of attendees at the EVTm conference. Additionally, with a response rate of roughly 25%, this may not represent the opinions of the meeting attendees as a whole and hinders statistical comparisons between the pre- and post-conference groups. The majority of participants were European and as such the responses would be expected to reflect primarily REBOA practice patterns in Europe. As the survey was

anonymous, there was no mechanism to identify any participants who completed the survey both before and after the conference. Therefore, we are only able to surmise the general group population and consensus before and after the event, with no means of analyzing individual changes in opinion. While this survey of an international cadre of providers interested in endovascular management of trauma was the first of its kind, further investigation is needed to generate societal consensus

Table 4 REBOA time limits and preferred extension modality selected by participants before and after EVTm conference.

	Pre-Conference	Post-Conference	p
Maximum REBOA inflation time in Zone 1	<i>n</i> = 97 (%)	<i>n</i> = 86 (%)	
<30 minutes	37 (38.1)	30 (34.9)	0.65
<45 minutes	10 (10.3)	8 (9.3)	0.82
<60 minutes	5 (5.2)	5 (5.8)	1.00
No limit if patient remains unstable	16 (16.5)	16 (18.6)	0.71
Current data insufficient to provide recommendation	29 (29.9)	27 (31.4)	0.82
Maximum REBOA inflation time in Zone 3	<i>n</i> = 97 (%)	<i>n</i> = 87 (%)	
<30 minutes	10 (10.3)	4 (4.6)	0.14
<45 minutes	20 (20.6)	18 (20.7)	1.00
<60 minutes	15 (15.5)	16 (18.4)	0.60
No limit if patient remains unstable	30 (30.9)	32 (36.8)	0.40
Current data insufficient to provide recommendation	26 (26.8)	25 (28.7)	0.76
Most viable technique for prolonging REBOA time	<i>n</i> = 98 (%)	<i>n</i> = 87 (%)	
Intermittent complete occlusion (I-REBOA)	37 (37.8)	16 (18.4)	0.004
Complete followed by partial occlusion (P-REBOA)	61 (62.2)	71 (81.6)	0.004

guidelines, as well as future trials to develop criteria for optimal REBOA use.

CONCLUSION

Meetings such as EVTm bring providers together to share their experiences, are paramount to the continued development of novel treatments, and represent unique opportunities to probe opinions and practice patterns. REBOA is an exciting and important advance in the management of life threatening hemorrhage, however, its implementation has not been codified and there is much variation in practitioners understanding of its use. There appears to be support for utilizing REBOA in the prehospital and austere environments, where patients may benefit the most. Additionally, a significant portion of providers favor a multidisciplinary team approach and are comfortable with multiple specialties performing REBOA as long as they are appropriately trained. Continued investigation is needed to determine the appropriate indications, methods, and practical limitations of REBOA within this new hemorrhage management paradigm.

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APPENDIX

Survey questions 1–18 were administered pre-conference. Questions 1–22 were administered post-conference.

Q1 Which of the following best describes your professional practice?

- Interventional Radiologist
- Trauma Surgeon

- Vascular Surgeon
- Emergency Physician
- Other

Q2 Which best describes your region of practice?

- North America
- South America
- Asia
- Europe
- The United Kingdom
- Australia
- Africa
- New Zealand

Q3 How many years have you been practicing in your profession? (Years since COMPLETION of training)

- I am still in training
- 0–5 years
- 6–10 years
- 11–15 years
- >15 years

Q4 Who should primarily be responsible for the use of endovascular trauma management principles for trauma patients? (select all that apply)

- Vascular
- Surgeons
- Interventional
- Radiology
- Trauma surgeons
- Emergency medicine physicians
- A multidisciplinary team composed of a combination of the above

Q5 In your opinion, for which of the following patient populations is resuscitative endovascular occlusion of the aorta (REBOA) potentially indicated? (select all that apply)

- Bleeding victims of blunt trauma
- Bleeding victims of penetrating trauma
- Bleeding victims of combat injury in austere settings

Q6 In your opinion, in which of the following settings is REBOA potentially a feasible tool of hemorrhage control? (select all that apply)

- The prehospital environment
- The emergency department
- The operating room
- The intensive care unit
- An austere military environment

- Q7** Among bleeding trauma patients injured by BLUNT mechanisms, which of the following do you presently consider a contraindication to REBOA use? (select all that apply)
- Evidence of bleeding in the neck
 - Evidence of bleeding in the chest
 - Evidence of abdominal or pelvic bleeding
 - Evidence of long bone fractures of the extremities
 - Evidence of associated intracranial injury/bleeding
- Q8** Among bleeding trauma patients injured by PENETRATING mechanisms, which of the following do you presently consider a contraindication to REBOA use? (select all that apply)
- Penetrating neck injury
 - Penetrating chest injury
 - Penetrating abdominal injury
 - Penetrating extremity injury with significant bleeding
 - Evidence of associated head injury
- Q9** In your opinion, which of the following BEST describes the relationship between indications for emergent resuscitative thoracotomy and REBOA?
- The indications for these procedures are largely identical
 - The indications are completely different
 - The decision should be individualized in each instance
 - There is insufficient data on REBOA for me to comment at this time
- Q10** In your opinion, which of the following BEST DESCRIBES the physiologic parameters to select patients for REBOA use? (select ALL that you feel apply)
- Patients in extremis only (no pulse, no blood pressure)
 - Any unstable trauma victim with an initial systolic blood pressure <90 mmHg
 - Trauma victims with systolic blood pressure >90 mmHg, but mechanisms of injury suspicious for high early bleeding risk (ex. severe pelvic fracture, positive FAST exam)
 - Trauma victims with an initial systolic blood pressure <90 mmHg who do NOT respond at all to initial fluid or blood product administration
 - Trauma victims with an initial systolic blood pressure <90 mmHg who respond transiently to initial fluid or blood product administration
- Q11** Femoral artery access is a precursor for potential REBOA use, but does not mandate subsequent REBOA. In your opinion, which of the following patient types should undergo EARLY femoral artery access? (Select all the apply)
- Patients in extremis only (no pulse, no blood pressure)
 - Every trauma victim presenting with initial systolic blood pressure < 90 mm Hg
 - Trauma victims with systolic blood pressure > 90 mm Hg, but mechanisms of injury suspicious for high early bleeding risk (ex. severe pelvic fracture, positive FAST exam)
 - Trauma victims with an initial systolic blood pressure < 90 mm Hg who do not respond at all to initial fluid or blood product administration
 - Trauma victims with an initial systolic blood pressure < 90 mm Hg who respond transiently to initial fluid or blood product administration
- Q12** In your opinion, in what settings is common femoral artery access for potential REBOA appropriate? (select all that apply)
- Prehospital
 - Emergency Department
 - Interventional Suite
 - Operating room/hybrid suite
 - Intensive Care Unit
- Q13** In your opinion, what is the ideal practice for confirming REBOA balloon position BEFORE INFLATION when this adjunct is used in an EMERGENT setting? (select all that you feel are appropriate if available)
- Using external body markings alone (ex. distance to xiphoid for Zone 1 or umbilicus for Zone 3) to determine insertion depth is appropriate in an emergency
 - Using standard predetermined distances of insertion alone is appropriate in an emergency REBOA placement
 - Plain radiography should routinely be used to confirm positioning before inflation
 - Fluoroscopy should routinely be used to confirm positioning before inflation
 - Ultrasound should routinely be used to confirm position before inflation
 - Computed tomography should routinely be used to confirm position before inflation
- Q14** In your opinion, what should be the RECOMMENDED REBOA inflation time that should be

undertaken for aortic occlusion in Zone 1 of the aorta (descending thoracic aorta) – (select the single answer most consistent with your opinion/thoughts)

- Never more than 30 minutes
- Never more than 45 minutes
- Never more than 60 minutes
- The time should not be limited if the patient remains unstable despite aggressive efforts
- Current data is insufficient for me to provide recommendations

Q15 In your opinion, how long should the RECOMMENDED maximum REBOA inflation time that should be undertaken for aortic occlusion Zone 3 of the aorta (infrarenal aorta)

- Never more than 30 minutes
- Never more than 60 minutes
- Never more than 120 minutes
- The time should not be limited if the patient remains unstable despite aggressive efforts
- Current data are insufficient to provide recommendations

Q16 In your opinion, who should optimally be performing REBOA for trauma victims (select all that apply)

- Vascular surgeons
- Trauma surgeons
- Interventional radiologists
- Emergency department physicians
- Any appropriately trained physician is appropriate

Q17 In your opinion, which of the following approaches is the MOST viable tool in prolonging the potential use of REBOA while attempting to avoid the dangers of distal ischemia? (Assuming that the patient tolerates either maneuver)

- Intermittent occlusion – releasing the balloon completely for short durations to allow distal perfusion before reinflating completely
- Early partial occlusion – transitioning to partial occlusion after a short period of full occlusion, but not letting the balloon down all the way or reinflating completely

Q18 Who should be responsible for removing the REBOA and vascular access sheath when the device is no longer needed? (Select BEST answer in your opinion)

- Any appropriately trained physician
- Vascular surgeon
- Trauma surgeon
- Interventional radiologist

Q19 Do you agree or disagree with the following statement? CLINICALLY OBVIOUS traumatic brain injury at presentation (altered pupillary exam, lateralizing signs on exam, depressed skull fracture, penetrating injury to the skull) should be considered a contraindication to REBOA at this time.

- Agree
- Disagree

Q20 Do you agree or disagree with the following statement? Occult traumatic brain injury identified on emergent head imaging (NO EVIDENCE of altered pupillary exam, lateralizing signs on exam, depressed skull fracture on physical exam, penetrating injury to the skull) should not be considered a contraindication to REBOA at this time.

- Agree
- Disagree

Q21 Do you agree or disagree with the following statement? Penetrating thoracic injury should be considered a contraindication to REBOA at this time.

- Agree
- Disagree

Q22 Do you agree or disagree with the following statement? REBOA can be safely and effectively performed in a variety of settings and by providers of various clinical backgrounds – PROVIDED THAT they have APPROPRIATE training and local protocols for use.

- Agree
- Disagree