THE ROLE OF REBOA IN CONTROL OF EXSANGUINATING TORSO HEMORRHAGE

Walter L. Biffl, M.D.

Medical Director, Acute Care Surgery, The Queen's Medical Center

Professor and Associate Chair for Research, Department of Surgery, JABSOM/University of Hawaii Manoa

THE PROBLEM

Noncompressible Hemorrhage in Chest / Abdomen / Pelvis

Fate of the Patient Depends on:

- **Decision Making**
- **Resources**
- **Efficacy of Interventions**

THE SOLUTION – IN EVOLUTION

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

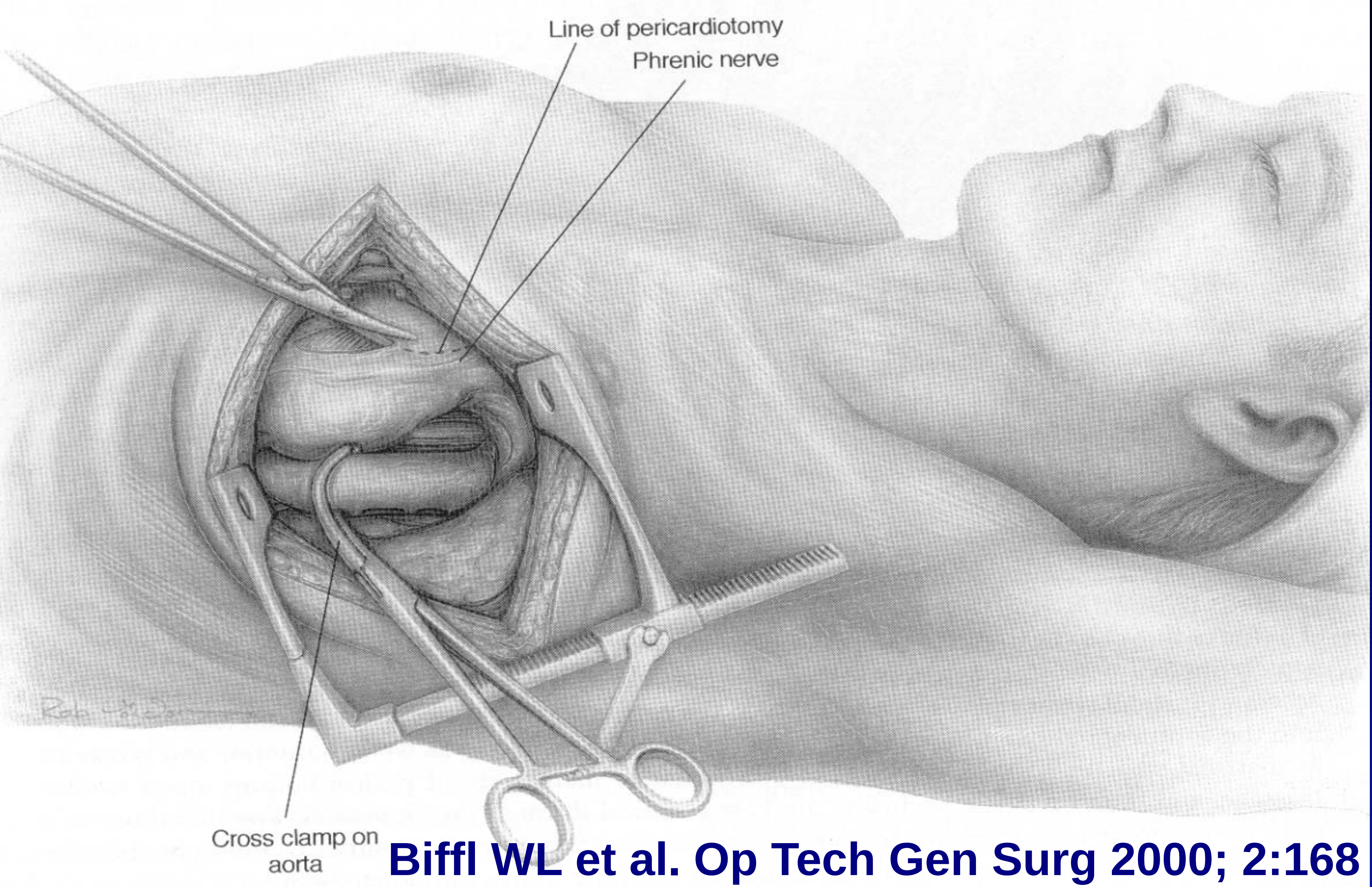
Abstract

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.

THE SOLUTION – IN EVOLUTION

Lack of familiarity with technique +
Potential mesenteric and spinal ischemia +
Concerns for technical complications +
Unfortunate outcomes
= No widespread adoption

RESUSCITATIVE THORACOTOMY



Biffl WL et al. Op Tech Gen Surg 2000; 2:168

THE JOURNAL OF TRAUMA
Vol. 16, No. 8
Printed in U.S.A.

THE ROLE OF THORACIC AORTIC OCCLUSION FOR MASSIVE HEMOPERITONEUM

ANNA M. LEDGERWOOD, M.D., MARIS KAZMERS, M.D., AND CHARLES E. LUCAS, M.D.
From the Department of Surgery, Wayne State University School of Medicine, Detroit, Michigan

0022-5282/84/2405-0387$02.00/0
THE JOURNAL OF TRAUMA
Vol. 24, No. 5
Printed in U.S.A.

Outcome of Resuscitative Thoracotomy and Descending Aortic Occlusion Performed in the Operating Room

J. SCOTT MILLIKAN, M.D., AND ERNEST E. MOORE, M.D.

0022-5282/89/2906-0861$02.00/0
THE JOURNAL OF TRAUMA

Vol. 29, No. 6
Printed in U.S.A.

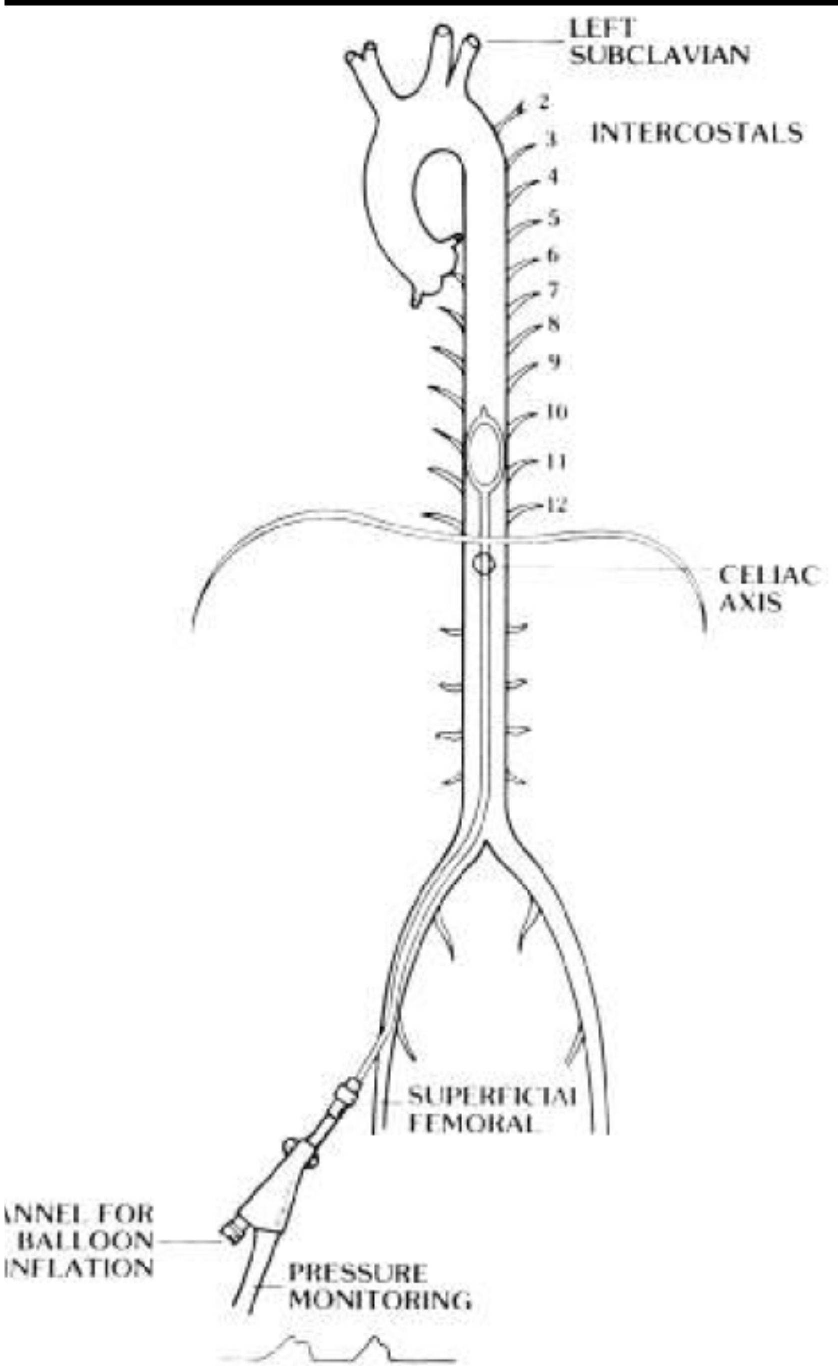
The Role of Intra-aortic Balloon Occlusion in Penetrating Abdominal Trauma

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.

	Survival
Group 1 - No BP in ED	0 / 5 (0%)
Group 2 – Preop Massive Hemoperitoneum	3 / 6 (50%)
Group 3 – Intraop IABO	4 / 10 (40%)

Complications. Three serious complications related 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.



MILITARY REINVIGORATION

Death on the battlefield (2001–2011): Implications for the future of combat casualty care

Brian J. Eastridge, MD, Robert L. Mabry, MD, Peter Seguin, MD, Joyce Cantrell, MD, Terrill Tops, MD, Paul Uribe, MD, Olga Mallett, Tamara Zubko, Lynne Oetjen-Gerdes, Todd E. Rasmussen, MD, Frank K. Butler, MD, Russell S. Kotwal, MD, John B. Holcomb, MD, Charles Wade, PhD, Howard Champion, MD, Mimi Lawnick, Leon Moores, MD, *and* Lorne H. Blackbourne, MD

For the study interval between October 2001 and June 2011, 4,596 battlefield fatalities were reviewed and analyzed. The stratification of mortality demonstrated that 87.3% of all injury mortality occurred in the pre-MTF environment. Of the pre-MTF deaths, 75.7% (n = 3,040) were classified as nonsurvivable, and 24.3% (n = 976) were deemed potentially survivable (PS). The injury/physiologic focus of PS acute mortality was largely associated with hemorrhage (90.9%). The site of lethal hemorrhage was truncal (67.3%), followed by junctional (19.2%) and peripheral-extremity (13.5%) hemorrhage.

MAINSTREAM USE

ELSEVIER
SAUNDERS

SURGICAL
CLINICS OF
NORTH AMERICA

Surg Clin N Am 87 (2007) 1035–1045

Ruptured Abdominal Aortic Aneurysms: Remote Aortic Occlusion for the General Surgeon

CPT Zachary M. Arthurs, MD[a,*],
CPT Vance Y. Sohn, MD[a],
Benjamin W. Starnes, MD, FACS[b]

[a]*Department of Surgery, Madigan Army Medical Center, Fitzsimmons Drive, Building 9040, Tacoma, WA 98431, USA*
[b]*Division of Vascular Surgery, University of Washington, Harborview Medical Center, 325 Ninth Avenue, Seattle, WA 98104, USA*

A clinical series ... lloon occlusion of the aort ... suscitation

Megan L. Brenner ... orge H. Tyson, MD,
Michelle K. McNutt, M ... homas M. Scalea, MD,

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 of injury	MVC	GSW	GSW	MVC	MCC	ATV collision
Injury Severity Score (ISS)	28	50	9	25	48	43
SBP before REBOA, mm Hg	70	70	0	60	70	85
Cardiac arrest before REBOA	No	No	Yes	No	No	No
SBP after REBOA, mm Hg	135	122	100	110	130	125
Admission base deficit	12	4	NA	16	14	19
Time to occlusion, min	5	4	4	6	6	6
Time of occlusion, min	12	16	70	60	65	36
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)

J Trauma Acute Care Surg 2013; 75:506

SHOCK, Vol. 41, No. 5, pp. 388–393, 2014

Indications for REBOA
n (%) = 244 (18.5%)
Mean ISS (SD) = 51 (21)
Mortality, n (%) = 173 (70.9)

Signs-of-Life En-Route
n = 165
Mean ISS (SD) = 44 (19)
Mortality, n (%) = 95 (57.6%)

I … CLUSION
… RELY

Jon … sen,§‖ Mark J.

*Academic … c Department of Military
Surg… 9th Medical Wing,
Lack… tment of Surgery,
The Unif… ombat Casualty Care
Rese… Research, Surgical
Reconstruc… ngham; **144 Parachute
M… Royal Infirmary

Zone I	… III
High-grade (AIS …	…) injury to
• Liver/kidney/s…	… h ring disruption
• Mesenteric dis…	… sel injury
• Named abdominal vessel injury	• Traumatic amputation at/near hip

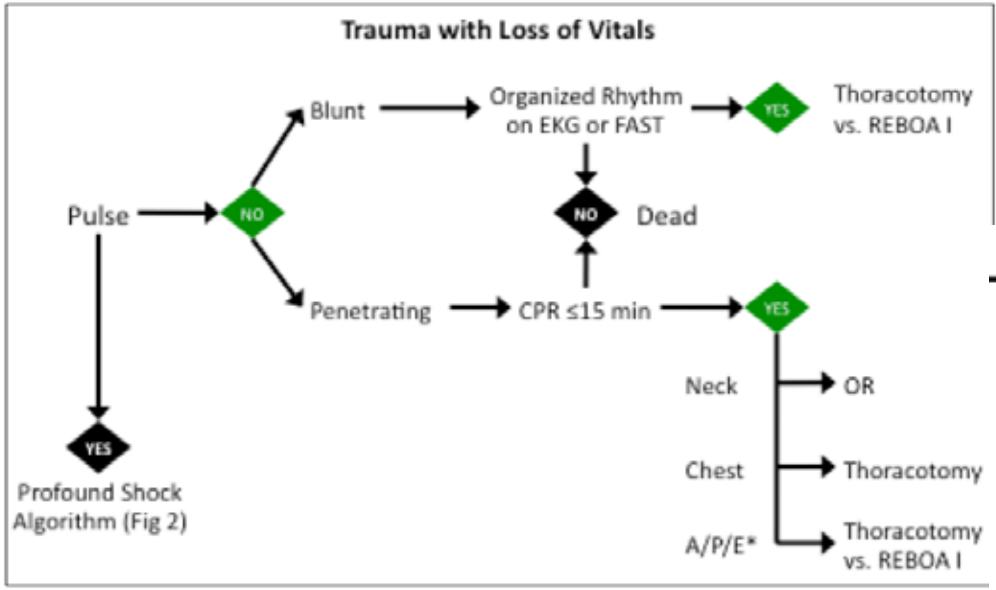
Joint Theater Trauma System Clinical Practice Guideline

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

Original Release/Approval		16 Jun 2014	Note: This CPG requires an annual review.	
Reviewed:	05 May 2014	Approved:	16 Jun 2014	
Supersedes:	**This is a new CPG and must be reviewed in its entirety.**			
☐ Minor Changes *(or)*	☒ **Changes are substantial and require a thorough reading of this CPG (or)**			
☐ Significant Changes				

Joint Theater Trauma System Clinical Practice Guideline

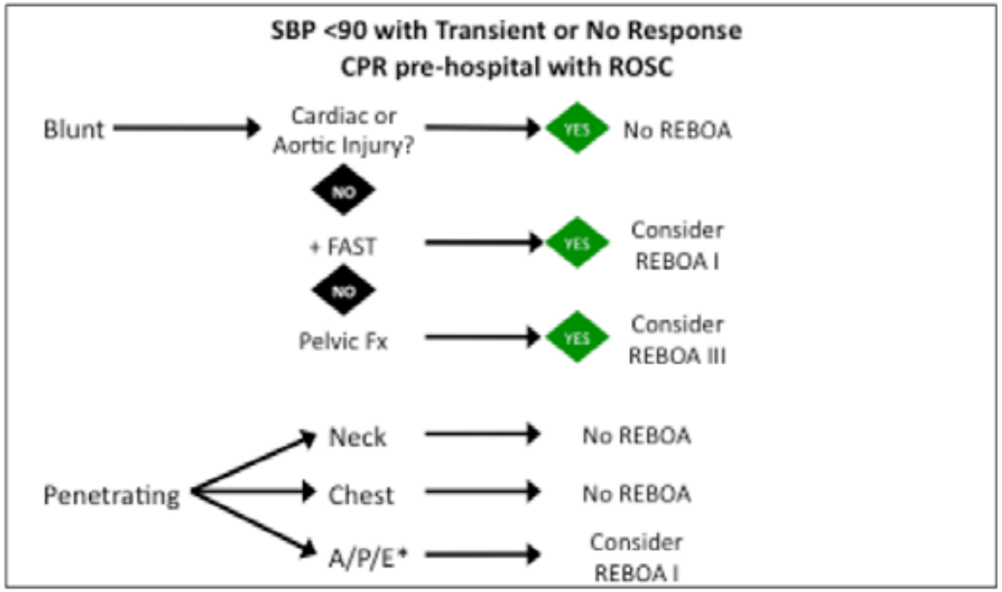
APPENDIX A TRAUMATIC ARREST ALGORITHM



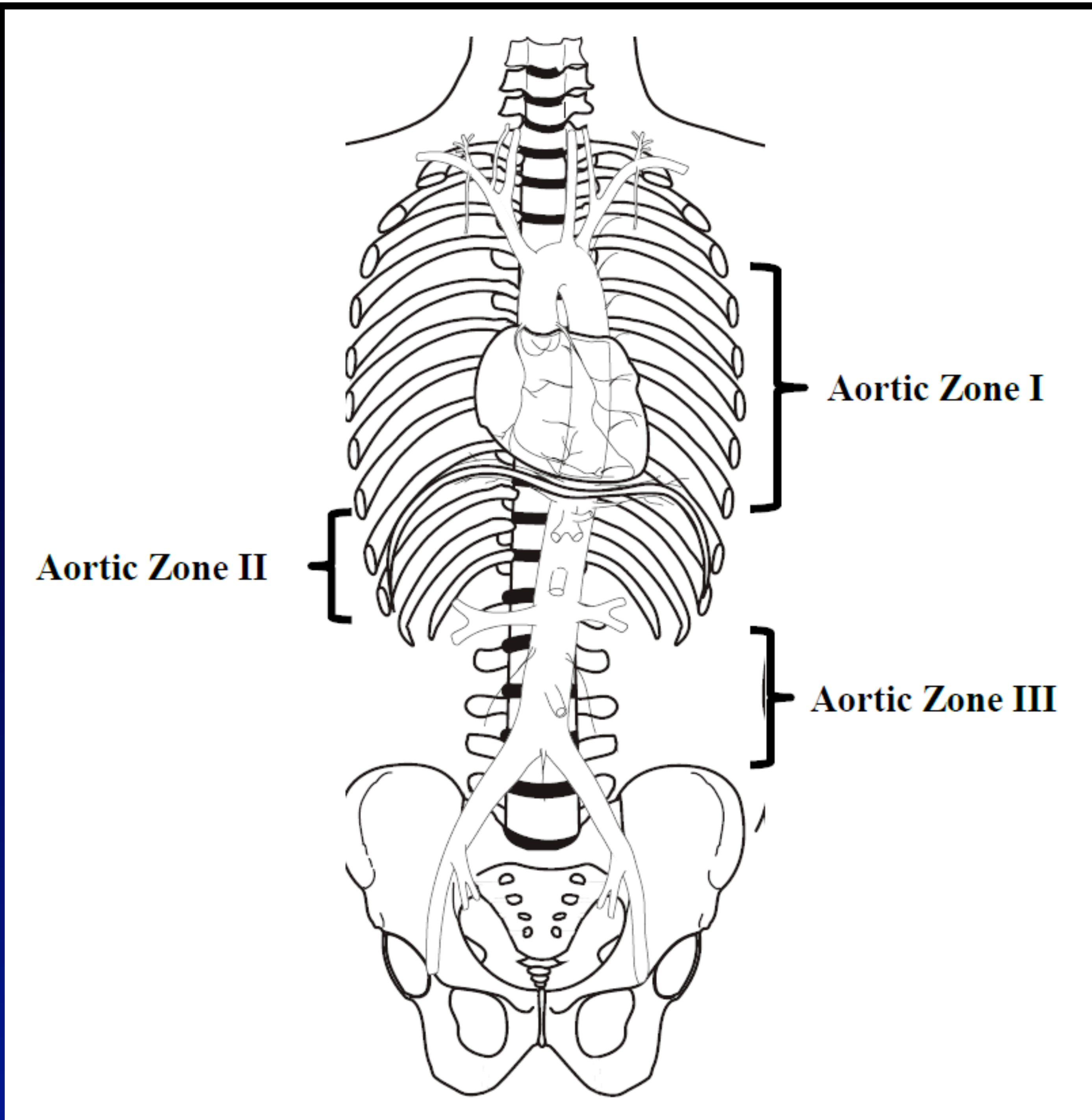
*Abdomen/Pelvis/Extremity; REBOA I=Placement of aortic balloon in the thoracic aorta (2-8 cm above the xyphoid)

Joint Theater Trauma System Clinical Practice Guideline

APPENDIX B ALGORITHM FOR THE MANAGEMENT OF PROFOUND SHOCK



*Abdomen/Pelvis/Extremity; ROSC, Return of Spontaneous Circulation; REBOA I Placement of aortic balloon in the thoracic aorta (2-8 cm above the xyphoid); REBOA III Placement of aortic balloon directly above the aortic bifurcation (1-2 cm above the umbilicus)


Aortic Zone I
Aortic Zone II
Aortic Zone III

< WA NEWS

Simple device is saving lives

EXCLUSIVE Cathy O'Leary Medical Editor

Friday, 6 February 2015 4:45PM

Lifesaver: Trauma surgeon Dieter Weber with the device. Picture: Ian Munro/The West Australian

Nonoperative management of hemodynamically unstable

TABLE 1. Clinical Characteristics

	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Patient 6	Patient 7
Age	58	79	64	69	55	46	64
Sex	Male	Male	Male	Male	Male	Male	Male
Mechanism	Blunt	Blunt	Blunt	Blunt	Blunt	Blunt	Blunt
ISS	75	59	50	25	48	54	41
Liver injury	Grade II	—	Grade V	Grade IV	—	—	—
Splenic injury	—	Grade IV	—	—	Grade III	Grade IV	Grade III
FAST scan	Negative	Positive	Positive	Positive	Negative	Positive	Positive
Renal injury	Grade IV	—	—	—	Grade IV	Grade III	Grade II
Retroperitoneal hemorrhage	Yes	No	No	No	Yes	Yes	No
Pelvic fracture	Stable fracture	No	No	No	Stable fracture	No	Stable fracture
Femoral fracture	No	Yes	No	No	No	No	Yes
SBP before REBOA, mm Hg	80	80	99	74	84	71	78
SBP after REBOA, mm Hg	90	130	139	135	92	190	153
PRBC within 24 h, mL/U	6,000 mL/50 U	3,600 mL/30 U	2,400 mL/20 U	6,240 mL/52 U	3,600 mL/30 U	2,640 mL/22 U	1,200 mL/10 U
FFP within 24 hours, mL/U	5,400 mL/60 U	6,300 mL/70 U	900 mL/10 U	4,050 mL/45 U	2,700 mL/30 U	2,700 mL/30 U	1,800 mL/20 U
PC within 24 hours, mL/U	1,000 mL/50 U	1,200 mL/60 U	600 mL/30 U	600 mL/30 U	200 mL/10 U	200 mL/10 U	250 mL/15 U
FFP/PRBC ≥ 1, U	Yes	Yes	No	Yes	Yes	Yes	Yes
Total occlusion time, min	No deflation	97	74	85	150	43	33
REBOA-related complications	No	No	No	No	No	No	No
Additional operative management	No	No	No	No	No	No	No
28-d outcome	Dead	Alive	Alive	Alive	Alive	Alive	Alive

FFP, fresh frozen plasma; PC, platelet concentrate; PRBC, packed red blood cell; SBP, systolic blood pressure.

J Trauma Acute Care Surg 2015; 78:132

Traumatic intra-abdominal hemorrhage control: Has current technology tipped the balance toward a role for prehospital intervention?

Muzzafer Chaudery, MRCS, James Clark, MRCS, Mark H. Wilson, FRCS, Duncan Bew, FRCS, Guang-Zhong Yang, PhD, *and* **Ara Darzi, FRS,** *London, United Kingdom*

J Trauma Acute Care Surg 2015; 78:153

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 2015; 78:721

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

CONCLUSION: REBOA treatment is associated with higher mortality compared with similarly ill trauma patients who did not receive a REBOA. The higher observed mortality among REBOA-treated patients may signal "last ditch" efforts for severity not otherwise identified in the trauma registry. (*J Trauma Acute Care Surg*. 2015;78: 721–728. Copyright © 2015 Wolters Kluwer

Evaluation of the safety and feasibility of resuscitative endovascular balloon occlusion of the aorta

J Trauma Acute Care Surg 2015; 78:897

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*

aortic occlusion was shorter in survivors than in deaths (21 minutes vs. 35 minutes, $p = 0.05$). The mean systolic blood pressure was significantly increased by REBOA (from 53.1 [21] mm Hg to 98.0 [26.6] mm Hg, $p < 0.01$). There were three cases with complications (12.5%), one external iliac artery injury and two lower limb ischemias in which lower limb amputation was necessary in all cases. Acute kidney injury developed in all three cases, but failure was not persistent.

REBOA seems to be feasible for trauma resuscitation and may improve survivorship. However, the serious complication of lower limb ischemia warrants more research on its safety. (*J Trauma Acute Care Surg*. 2015;78: 897–904. Copyright © 2015

- Is It Safe?
- Can it Replace RT?
- Does it Make Sense?

CURRENT OPINION

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 2015; 78:1054

Algorithm for Control of Torso Hemorrhage

Localize Hemorrhage with CXR, FAST, Pelvis X-Ray

		A	B	C	D
	SBP	CPR	<60	60-80	> 80
1	Thoracic Hemorrhage	EDT	EDT	EDT vs OR	OR Thoracotomy
2	Abdominal Hemorrhage	EDT	EDT vs REBOA	OR vs REBOA	OR Laparotomy
3	Pelvic Hemorrhage	EDT	REBOA vs EDT	REBOA	OR Pelvic Packing

Biffl et al. J Trauma Acute Care Surg 2015; 78:1054

INTERNAL CARDIAC MASSAGE Vs CPR

	% Pre-Arrest Blood Flow	
	Closed	Open
Cerebral Cortex Perfusion	10%	100%
Cardiac Output	25%	50%

Jackson et al. Emerg Med Clin North Am 1983; 1:501

Blood Flow in the Cerebral Cortex During Cardiac Resuscitation in Dogs

Regional cerebral cortical blood flow (rCCBF) in 15 large dogs was determined using the double thermistor dilution method during standard closed-chest massage (CCM), CCM with an epinephrine infusion at 30 μg/kg/min (CCM+Epi), and open-chest cardiac massage (OCCM). As a percentage of prearrest flow values, the rCCBF was 9.8% with CCM, 35% with CCM+Epi, and 156% with OCCM. The rCCBF was reduced significantly with CCM (P < .005) and CCM+Epi (P < .01). OCCM generated flows indistinguishable from prearrest values. The use of high-dose epinephrine significantly increased the rCCBF during CCM. The implications for intact neurologic resuscitation of these reductions in rCCBF with CCM are important. [Jackson RE, Joyce K, Danosi SF, White BC, Vigor D, Hoehner TJ: Blood flow in the cerebral cortex during cardiac resuscitation in dogs. Ann Emerg Med September 1984 (Part 1);13:657-659.]

Raymond E Jackson, MD*
Kathleen Joyce, MD*
Steve F Danosi, MD*
Detroit
Blaine C White, MD, FACEP†
East Lansing, Michigan
David Vigor*
Thomas J Hoehner*
Detroit

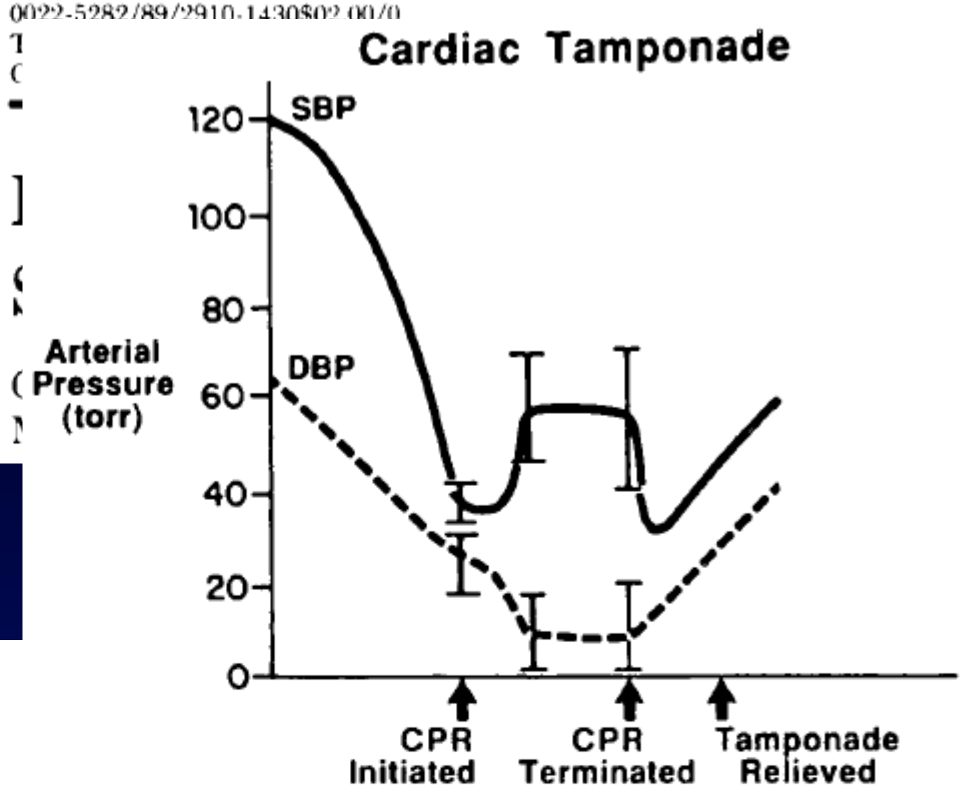
From the Section of Emergenc
Department of Surgery, Wayne
University School of Medicine,
and the Section of Emergency

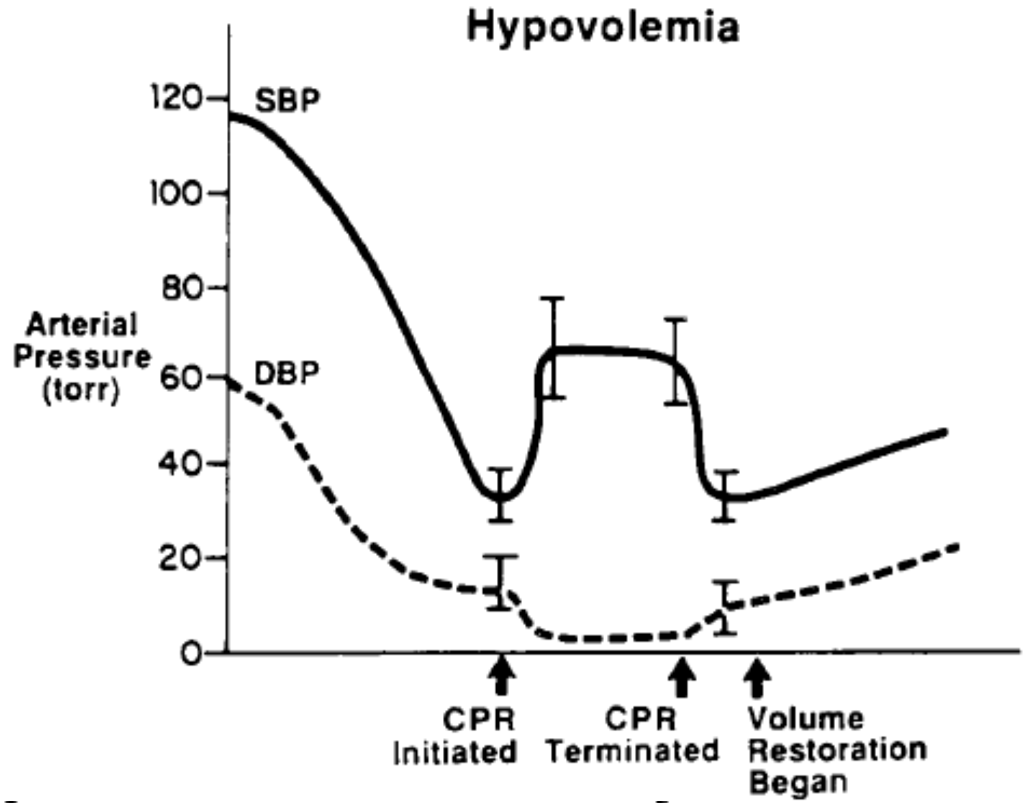
TABLE 1. *Effects of different forms of resuscitation on cerebral cortical blood flows*

Group	Pre-arrest cc/min/g	Resuscitation cc/min/g	Pre-arrest (%)	*P* Value
CCM	0.69 ± 0.24	0.06 ± 0.02	9.8 ± 3.4	< .005
CCM ± Epi	0.49 ± 0.16	0.15 ± 0.09	36.1 ± 22.3	< .01
OCCM	0.53 ± 0.16	0.83 ± 0.42	156.6 ± 79.2	> .05

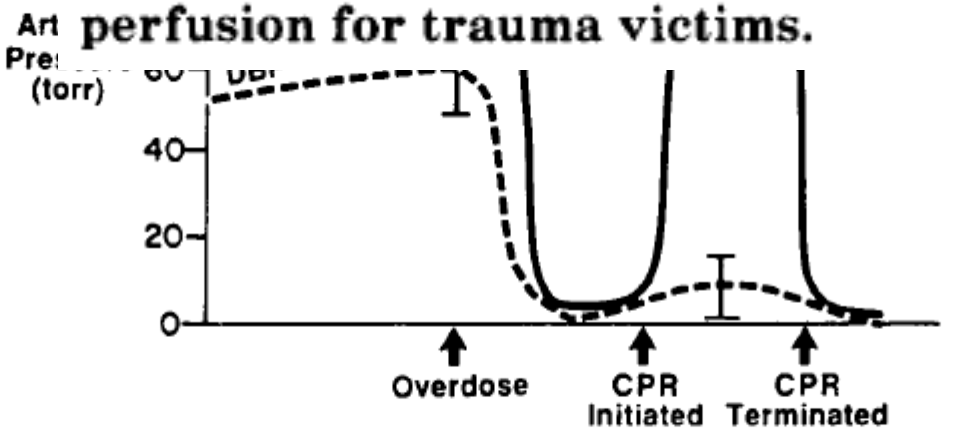
Ann Emerg Med 1984; 13:657

0022-5282/89/2910-1430$02.00/0





We conclude that CCCPR does not augment arterial pressure in the clinical situations associated with decreased LVEDV and is unlikely to provide organ perfusion for trauma victims.



J Trauma 1989; 29:1430

Open chest cardiac massage offers no benefit over closed chest compressions in patients with traumatic cardiac arrest

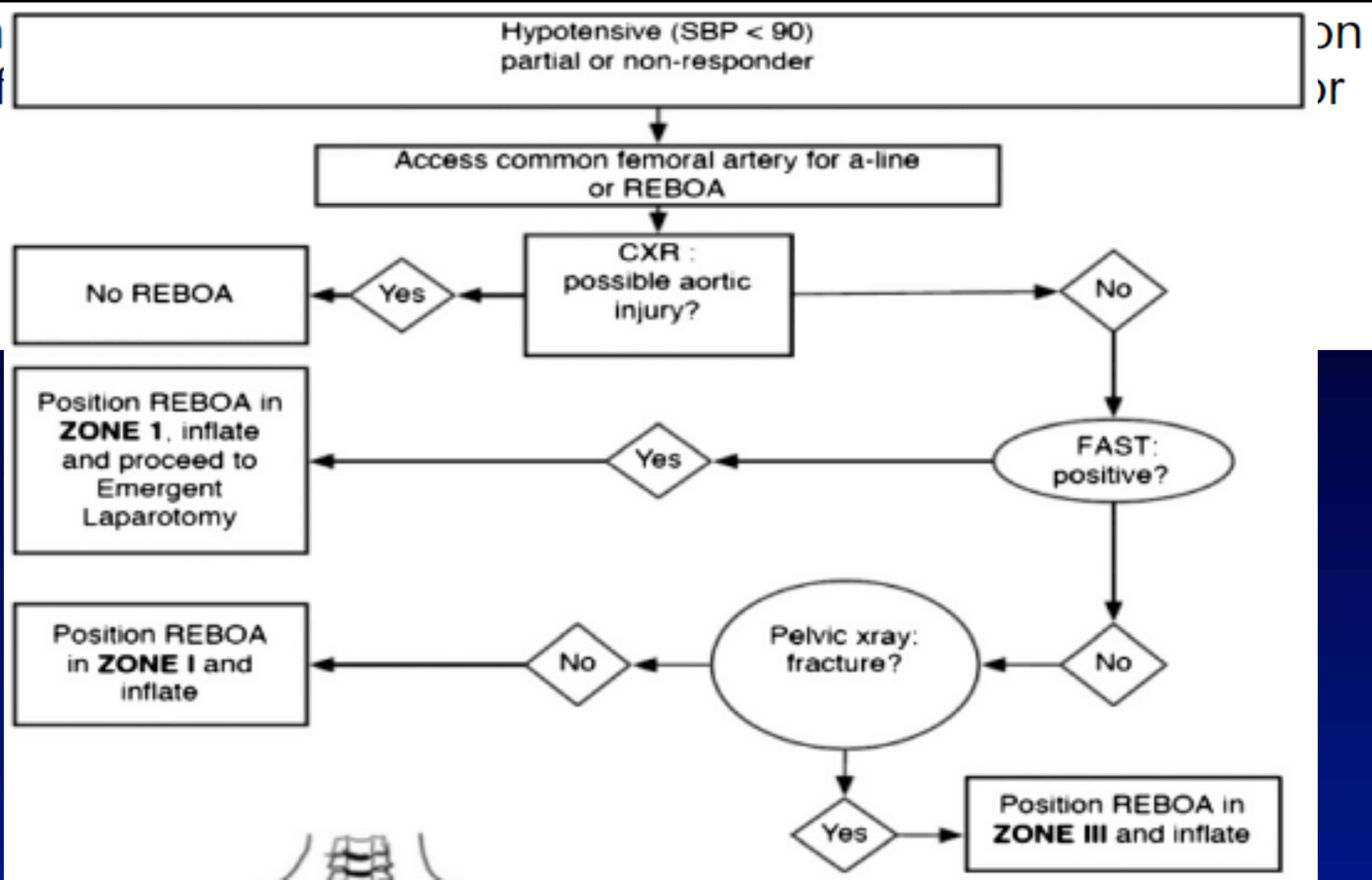
Matthew J. Bradley, MD, Brandon W. Bonds, MD, Luke Chang, Shiming Yang, PhD, Peter Hu, PhD, Hsiao-chi Li, MS, Megan L. Brenner, MD, Thomas M. Scalea, MD, *and* **Deborah M. Stein, MD, MPH,** *Baltimore, Maryland*

Observational Study Traumatic Arrest
Measured ROSC and ETCO2

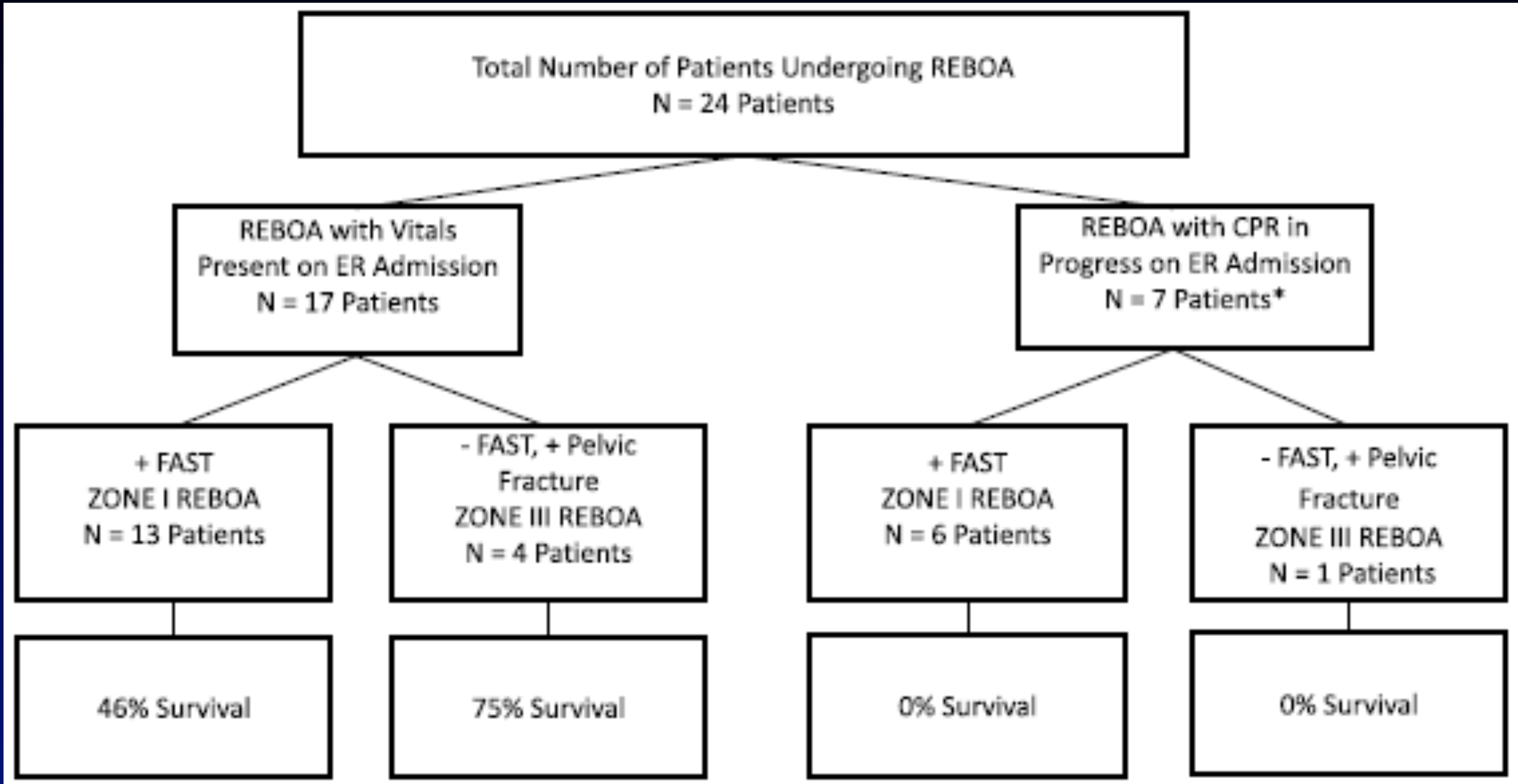
Although thoracotomy is necessary for the emergent surgical repair of thoracic injury, we found no sufficient evidence showing significant improvement in ROSC with OCCM. So far, it lacks evidence showing that OCCM could provide a physiologic advantage in improving CO as measured by $\mathrm{ETCO_2}$ when compared with equivalent periods of CCC. With newer endovascular techniques for aortic occlusion, thoracotomy solely for performing OCCM may not provide any benefit to the patient over CCC.

J Trauma Acute Care Surg 2016; 81:849

Im on
of or



J Trauma Acute Care Surg 2015; 79:523



J Trauma Acute Care Surg 2015; 79:523

The AAST prospective Aortic Occlusion for Resuscitation in Trauma and Acute Care Surgery (AORTA) registry: Data on contemporary utilization and outcomes of aortic occlusion and resuscitative balloon occlusion of the aorta (REBOA)

Joseph J. DuBose, MD, Thomas M. Scalea, MD, Megan Brenner, MD, Dimitra Skiada, MD, Kenji Inaba, MD, Jeremy Cannon, MD, Laura Moore, MD, John Holcomb, MD, David Turay, MD, Cassra N. Arbabi, MD, Andrew Kirkpatrick, MD, James Xiao, MD, David Skarupa, MD, Nathaniel Poulin, MD, ***and*** **the AAST AORTA Study Group**, *Davis, California*

Aortic occlusion for resuscitation after trauma remains a dramatic but crucial tool in the care of profoundly hypotensive patients after injury. Contemporary survival rates seem to have improved compared to historical controls, and good neurologic outcomes among survivors can be achieved. Resuscitative endovascular balloon occlusion of the aorta has emerged as a viable alternative to open AO in centers that have developed this capability, with similar outcomes to open AO techniques based on limited early data. Ongoing maturation of the AAST AORTA database is required to determine the impact of REBOA use.

J Trauma Acute Care Surg 2016; 81:409

RT vs REBOA, p<.05

- Transfer from OSF; Blunt vs Penetrating; Chest AIS; Field Intubation
- Median SBP, HR (0,0 vs 50, 85)
- Temperature
- Resident/Fellow (43% vs 4%)
- Post-Occlusion SBP (69 vs 90); Sustained SBP >90 (28% vs 51%)
- Mortality 84% vs 72%
- DC Dispo Home 12% vs 9%

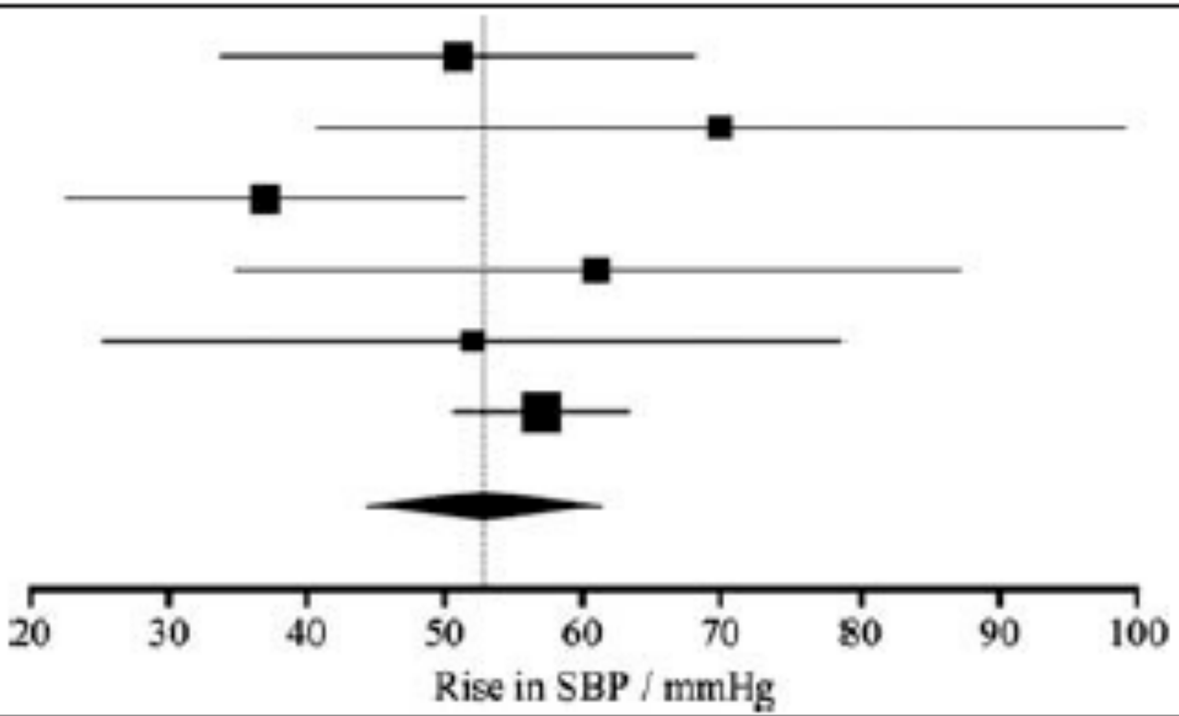
Dubose et al. J Trauma Acute Care Surg 2016 EPub

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

Jonathan James Morrison, MD, PhD, Richard E. Galgon, MD, MS, Jan Olaf Jansen, FRCS, FFICM, Jeremy W. Cannon, MD, SM, Todd Erik Rasmussen, MD,

Ref	Year	n	Weight	Mean SBP Rise (95% CI)
34	1989	16	16.3%	51 (33 – 68)
14	2010	13	7.1%	70 (41 – 99)
45	2012	6	20.4%	37 (23 – 51)
13	2013	6	8.7%	61 (35 – 87)
22	2015	7	8.3%	52 (25 – 79)
19	2015	14	39.2%	57 (51 – 63)
Overall Effect				53 (44 – 61)

Forrest Plot



Model: $p < 0.001$
Heterogeneity: $I^2 = 35.5$

Abbreviations: SBP – Systolic Blood Pressure; CI – Confidence Interval

J Trauma Acute Care Surg 2016; 80:324

Resuscitative endovascular balloon occlusion of the aorta might be dangerous in patients with severe torso trauma: A propensity score analysis

J Trauma Acute Care Surg 2016; 80:559

Junichi Inoue, MD, Atsushi Shiraishi, MD, PhD, Ayako Yoshiyuki, MD, Koichi Haruta, MD, Hiroki Matsui, MPH, *and* Yasuhiro Otomo, MD, PhD, *Tokyo, Japan*

- **REBOA Used in Japan Since 1990s**
- **Surgery / Embolization for Torso Hemorrhage**
- **625 Pts Each Group**

Subgroups	N With REBOA / Without REBOA	Mean difference (%) in mortality [95%CI]	P for interaction
Overall subjects	**625 / 625**	**16.5 [10.9, 22.0]**	
Gender			
Male	434 / 436	14.7 [8.0, 21.3]	0.347
Female	191 / 189	20.5 [10.3, 30.7]	
Age, y			
<60	372 / 369	19.4 [12.3, 26.5]	0.221
≥60	253 / 256	12.4 [3.8, 21.0]	
Type of trauma			
Blunt injury	586 / 586	17.8 [12.1, 23.5]	0.066
Penetrating injury	39 / 39	−3.7 [−25.9, 18.5]	
Glasgow Coma Scale			
9–15	379 / 391	17.1 [10.1, 24.1]	0.613
3–8	246 / 234	14.3 [5.9, 22.7]	
Systolic blood pressure, mmHg			
≥80	321 / 330	24.2 [16.6, 31.8]	0.003
<80	304 / 295	7.7 [−0.3, 15.7]	
AIS chest			
0-3	353 / 356	14.1 [6.8, 21.5]	0.377
4-5	272 / 269	19.3 [10.7, 27.8]	
AIS abdomen			
0-3	341 / 338	18.2 [10.5, 25.8]	0.512
4-5	284 / 287	14.4 [6.1, 22.7]	
AIS pelvis and lower extremities			
0-3	406 / 407	16.1 [9.2, 23.1]	0.876
4-5	219 / 218	17.1 [7.7, 26.5]	
Door to primary surgery time, minutes			
<60	132 / 124	3.2 [−9.6, 16.0]	0.029
≥60	493 / 501	19.8 [13.4, 26.2]	
Amount of REBOA per institute per year			
≥2	275 / 435	18.0 [10.3, 25.6]	0.755
<2	350 / 190	16.1 [7.3, 24.9]	
Transcatheter embolization			
No	441 / 411	11.0 [4.2, 17.7]	0.007
Yes	184 / 214	27.5 [17.6, 37.5]	

Figure 4. Subgroup analysis of mean differences in in-hospital mortality rates in association with REBOA.

CONSIDERATIONS

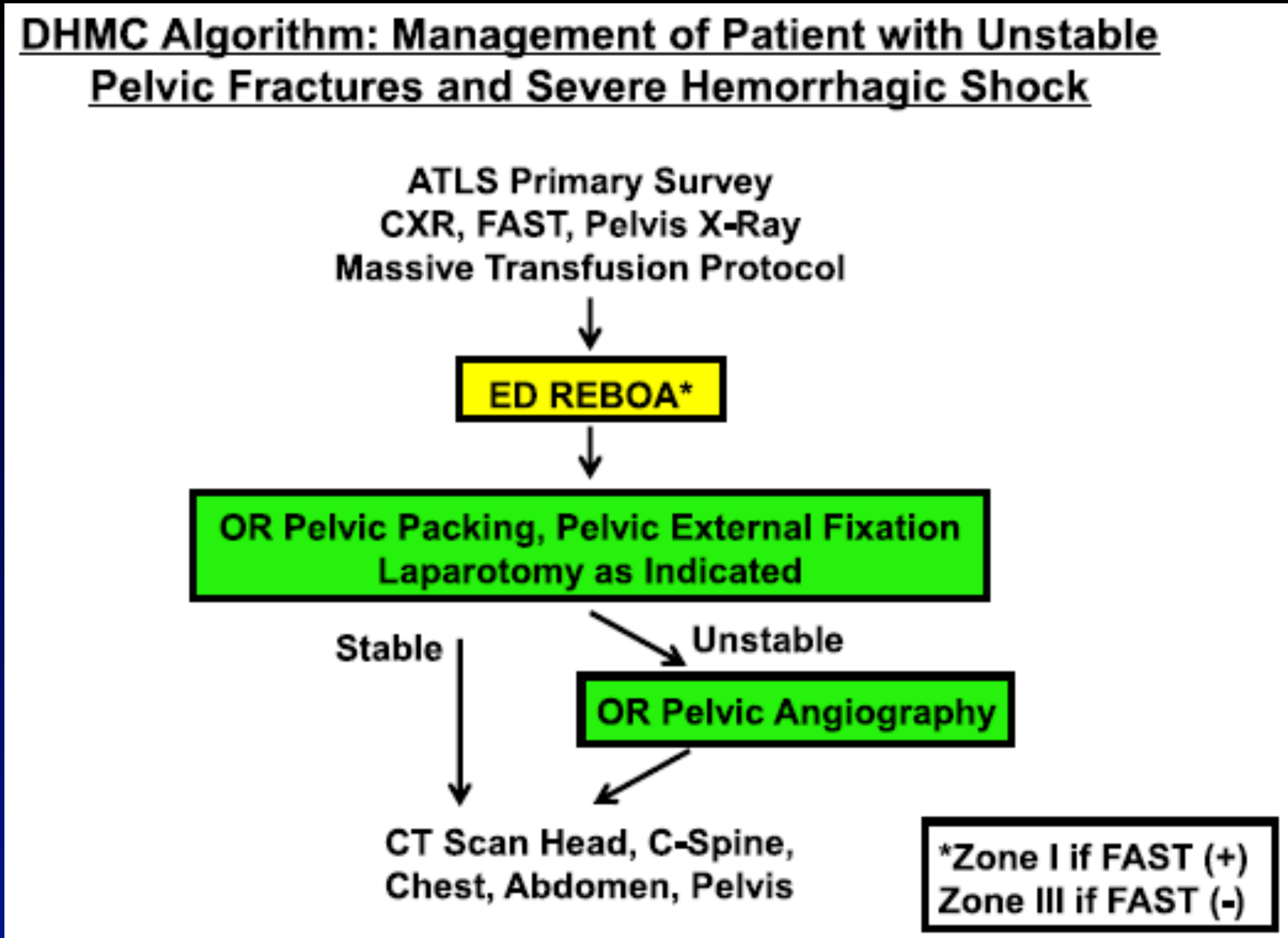
- Availability of resources (OR, equipment)
- Distance from definitive care
- Skill set
- Complication profile (RT vs REBOA)
- Time
- Cost / Resource Utilization

Algorithm for Control of Torso Hemorrhage

Localize Hemorrhage with CXR, FAST, Pelvis X-Ray

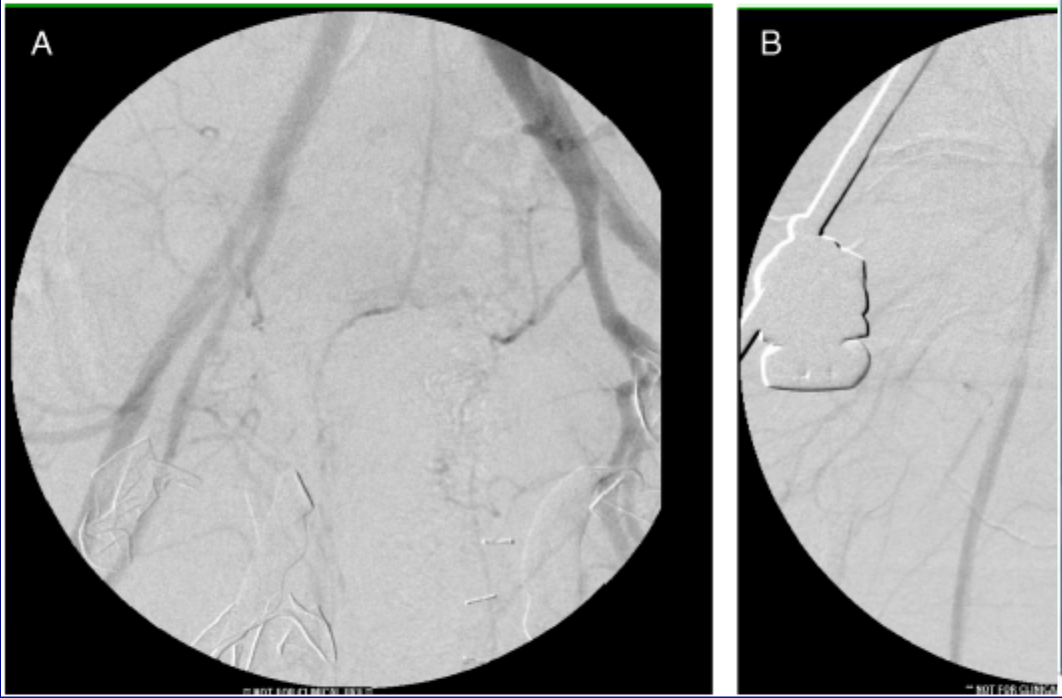
		A	B	C	D
	SBP	CPR	<60	60-80	> 80
1	Thoracic Hemorrhage	EDT	EDT	EDT vs OR	OR Thoracotomy
2	Abdominal Hemorrhage	EDT	EDT vs REBOA	OR vs REBOA	OR Laparotomy
3	Pelvic Hemorrhage	EDT	REBOA vs EDT	REBOA	OR Pelvic Packing

Biffl et al. J Trauma Acute Care Surg 2015; 78:1054



Biffl et al. J Trauma Acute Care Surg 2015; 78:1054


A
B
34


A
B

CURRENT AREAS OF INTEREST

- Simulators for Training (Brenner et al; Keller et al)
- Smaller Diameter Sheaths (Teeter et al; Taylor et al)
- Adjuncts to Insertion
- Fluoroscopy-Free / Fixed Distance (Scott et al; Sokol et al; Pezy et al; Linnebur et al)
- Ultrasound / Microbubbles (Chaudery et al)
- Partial Occlusion (Johnson et al; Russo et al)
- Prehospital Use (Sadek et al)

J Trauma 2011; 71:1869

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

STEP 1: ARTERIAL ACCESS AND POSITIONING OF INITIAL SHEATH

STEP 2: SELECTION AND POSITIONING OF THE BALLOON

STEP 3: INFLATION OF THE BALLOON AND SECURING OF THE APPARATUS

STEP 4: DEFLATION OF THE BALLOON

STEP 5: REMOVAL OF THE BALLOON AND SHEATH

TABLE 2. Examples of Endovascular Tools (Wires, Sheaths, and Balloons) Used To Accomplish REBOA

	Description	Size	Length (cm)
Wire	Amplatz Stiff Wire Guide (Cook Medical)	0.035 inch	260
Sheaths	Initial (starter)	5–6 Fr	8–15
	Delivery and support	12–14 Fr	45–60
Balloons	Coda balloon (Cook Medical)	14 Fr (32–40 mm diameter)	120
	Reliant (Medtronic)	12 Fr (10–46 mm diameter)	100
	Berenstein (Boston Scientific)	6 Fr (11.5 mm diameter)	80