THE ABDOMINAL AORTIC & JUNCTIONAL TOURNIQUET

Innovation at the edge of indication

Surg Capt Ed Barnard
Defence Professor of Emergency Medicine

edward.barnard@nhs.net

+44 (0) 7946 021207

@DefProfEM

Flat white


EURECA


RAID

CONFLICTS OF INTEREST

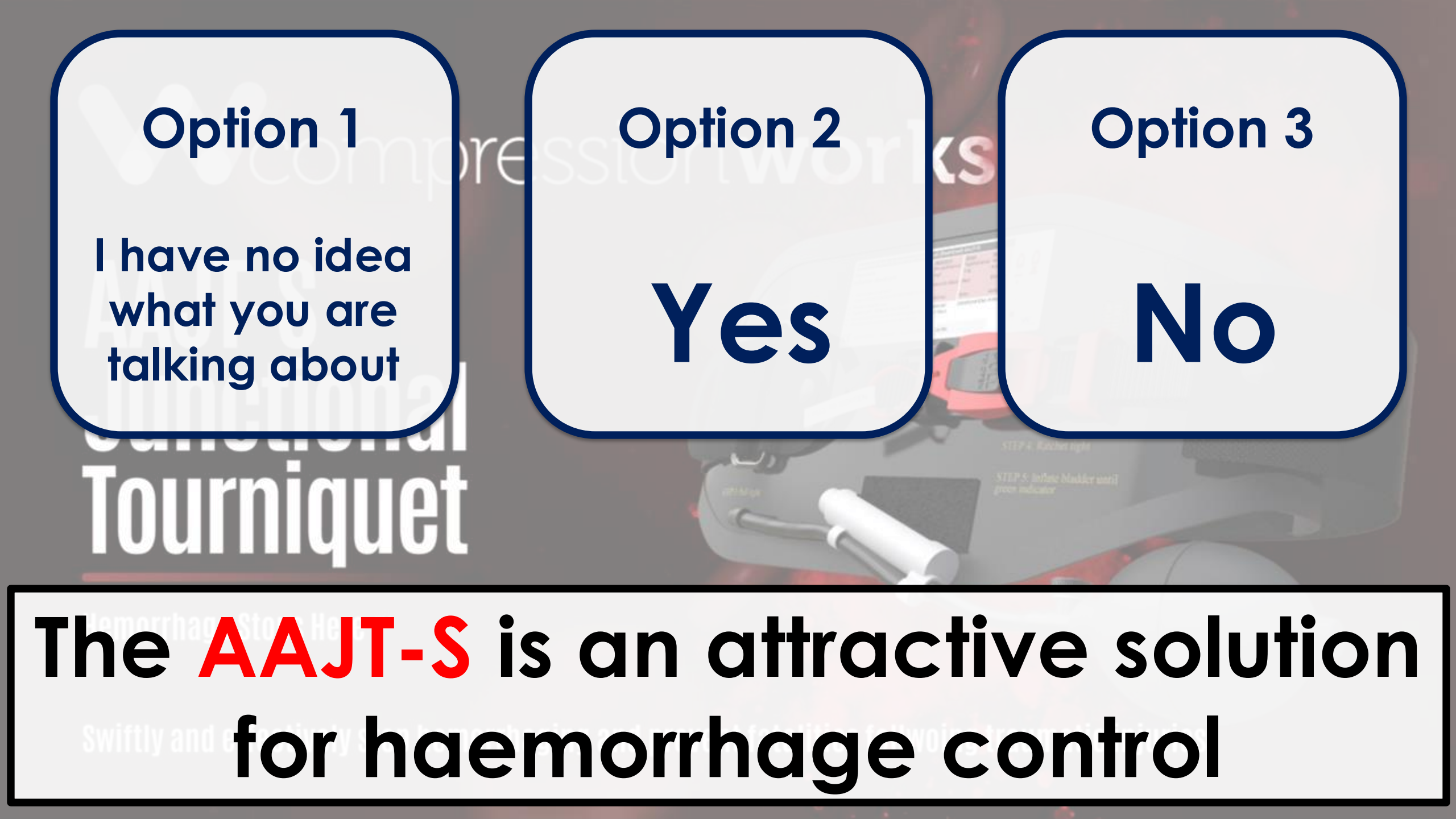
Serving Royal Navy Officer

Views are my own (non-attributable)

No financial disclosures

Background in large animal translational work in NCH / aortic balloon occlusion

Option 1	Option 2	Option 3
I have no idea what you are talking about	**Yes**	**No**

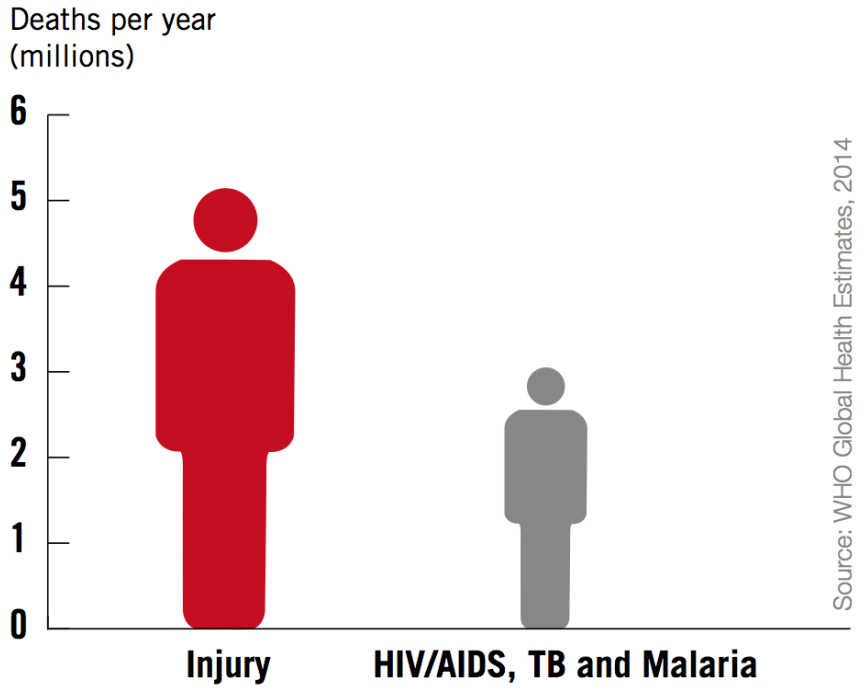


The AAJT-S is an attractive solution for haemorrhage control

Figure 1:

The scale of the problem

Injury deaths compared to other leading causes of mortality, world, 2012.



World Health Organization

Haemorrhage

Haemorrhage is the leading cause of potentially survivable trauma death[1-7]

Extremity haemorrhage – tourniquets reduced mortality by 85% in the military setting[2]

Bleeding everywhere else…. (chest, abdomen, pelvis)

1. National Audit Office. Major Trauma Care in England. February 2010. 2.Eastridge BJ, Mabry RL, Seguin P, et al. Death on the battlefield (2001-2011): implications for the future of combat casualty care. *J Trauma Acute Care Surg* 2012;73:S431–7. 3. Singleton JAG, Gibb IE, Hunt NCA, et al. Identifying future "unexpected" survivors: a retrospective cohort study of fatal injury patterns in victims of improvised explosive devices. *BMJ Open* 2013;3(8):e003130–0. 4. Chiara O, Scott JD, Cimbanassi S, et al. Trauma deaths in an Italian urban area: an audit of pre-hospital and in-hospital trauma care. *Injury* 2002;33(7):553–62. 5. Tien HC, Spencer F, Tremblay LN, et al. Preventable deaths from hemorrhage at a level I Canadian trauma center. *J Trauma* 2007;62(1):142–6. 6. Teixeira PGR, Inaba K, Hadjizacharia P, et al. Preventable or potentially preventable mortality at a mature trauma center. *J Trauma* 2007;63(6):1338–46.

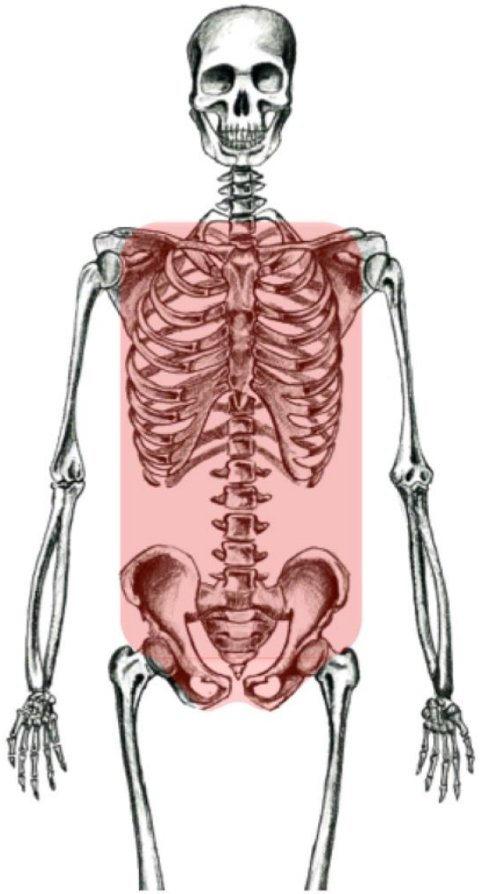
Military Trauma

UK/US deaths OIF/OEF – 7484[1]

81-90% of potentially survivable deaths were due to haemorrhage[2-4]

58-67% of these deaths were due to non-compressible torso haemorrhage (NCTH)[2-4]

1.www.icasualties.org, accessed 26th July 2015. 2. Kelly JF, *et al*. Injury severity and causes of death from Operation Iraqi Freedom and Operation Enduring Freedom: 2003-2004 versus 2006. *J Trauma* 2008. 3. Eastridge BJ, *et al*. Death of the Battlefield (2001-2011): Implications for the future of combat casualty care. *J Trauma* 2012. 4. Holcomb JB, *et al*. Causes of death in US Special Operations Forces in the Global War on Terrorism. *Ann Surg* 2007.



NCTH:

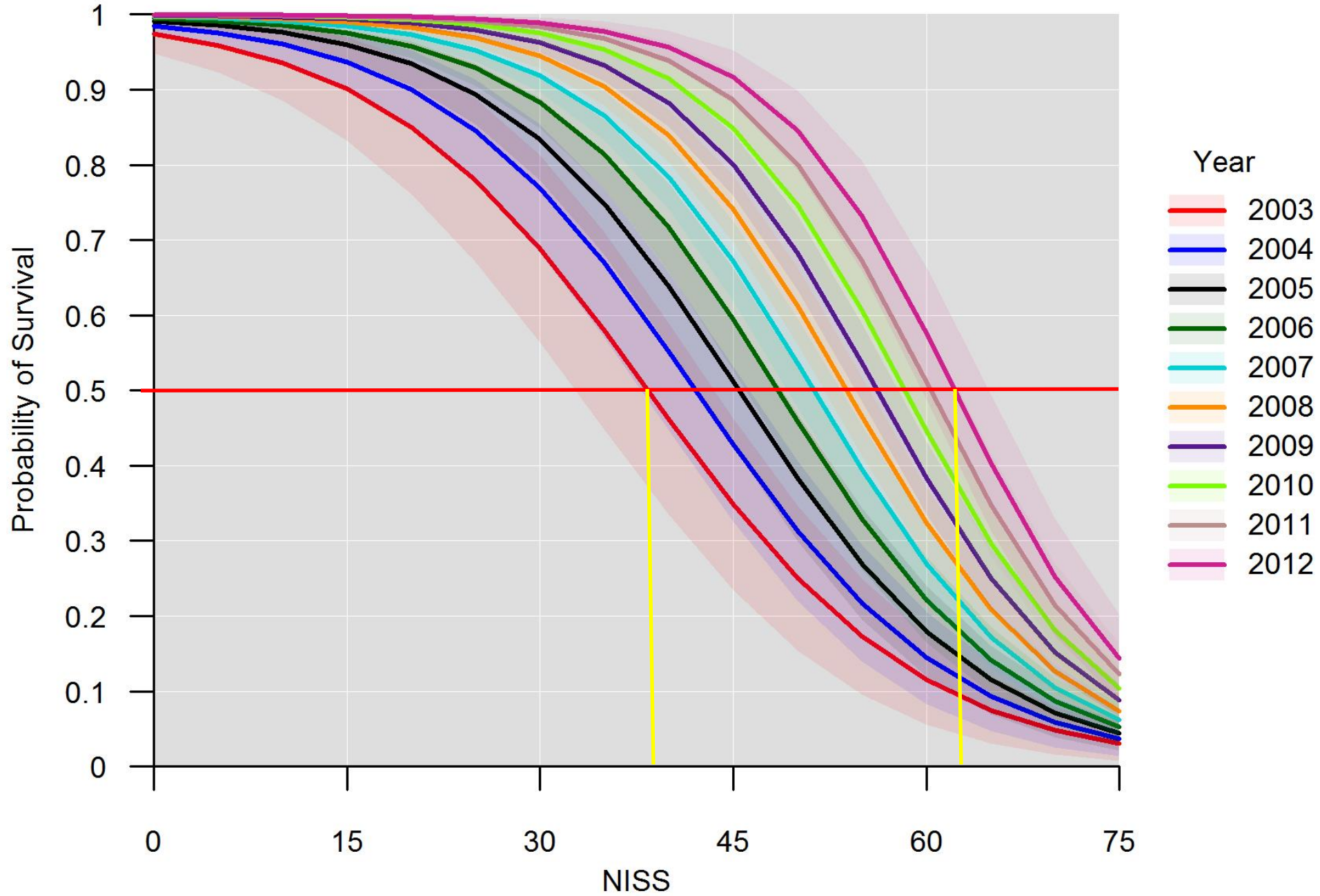
Vascular disruption to axial torso vessels, solid organs, pulmonary parenchyma, and / or the bony pelvis, when accompanied by shock[8]

32-85% mortality[9,10]

90% die pre-hospital[11]

40% in TCA on ED arrival[9]

8. Morrison JJ, *et al*. Non-compressible torso hemorrhage: a review with contemporary definitions and management strategies. *Surg Clin North Am*. 2012. 9. Barnard EBG, *et al*. Resuscitative endovascular balloon occlusion of the aorta (REBOA): a population based gap analysis of trauma patients in England & Wales. *Emerg Med J* 2015;32(1):926-32. 10. Kisat M, *et al*. Epidemiology and outcomes of non-compressible torso hemorrhage. *J Surg Res* 2013;184(1):414-21. 11. Morrison JJ, *et al*. Injury pattern and mortality of noncompressible torso hemorrhage in UK combat casualties. *J Trauma* 2013.


Probability of Survival
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
15
30
45
60
75
NISS
Year
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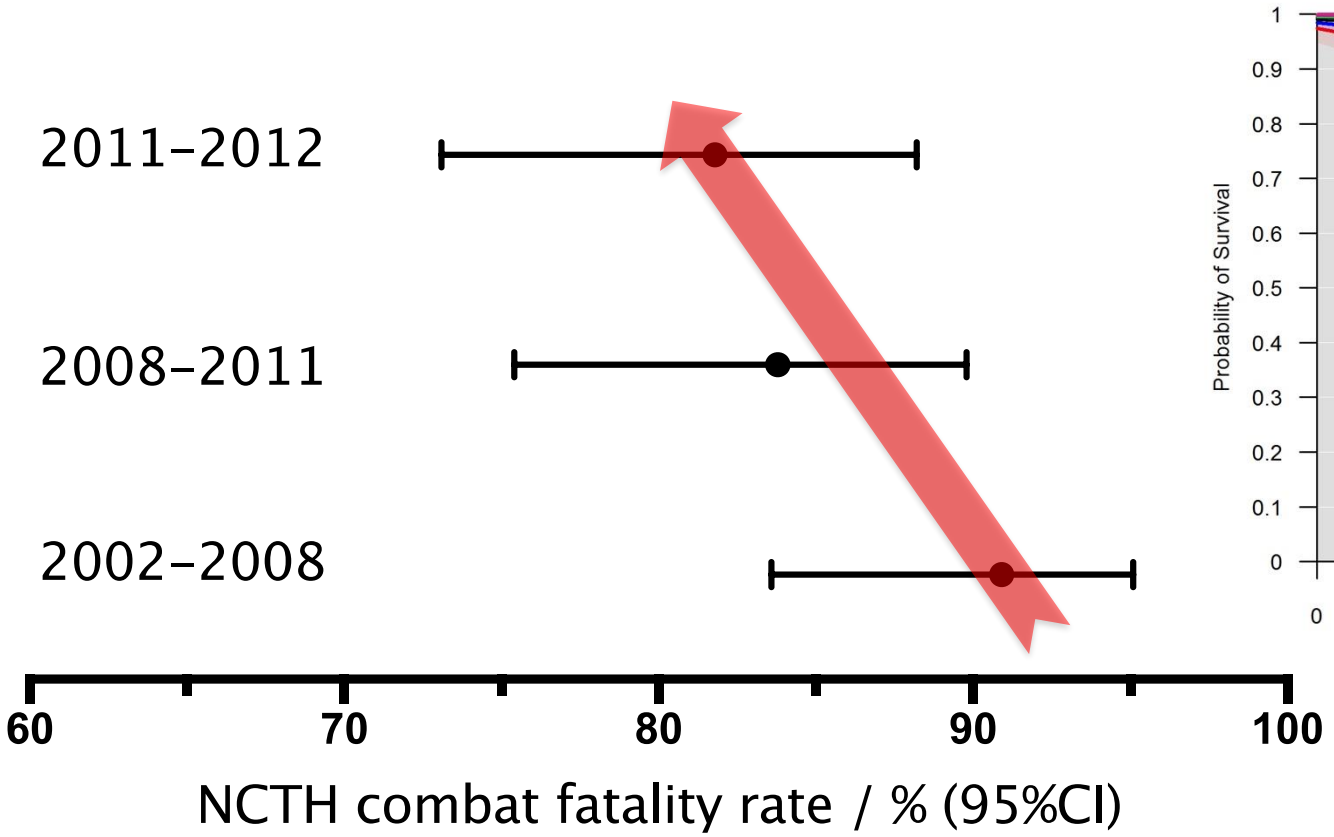
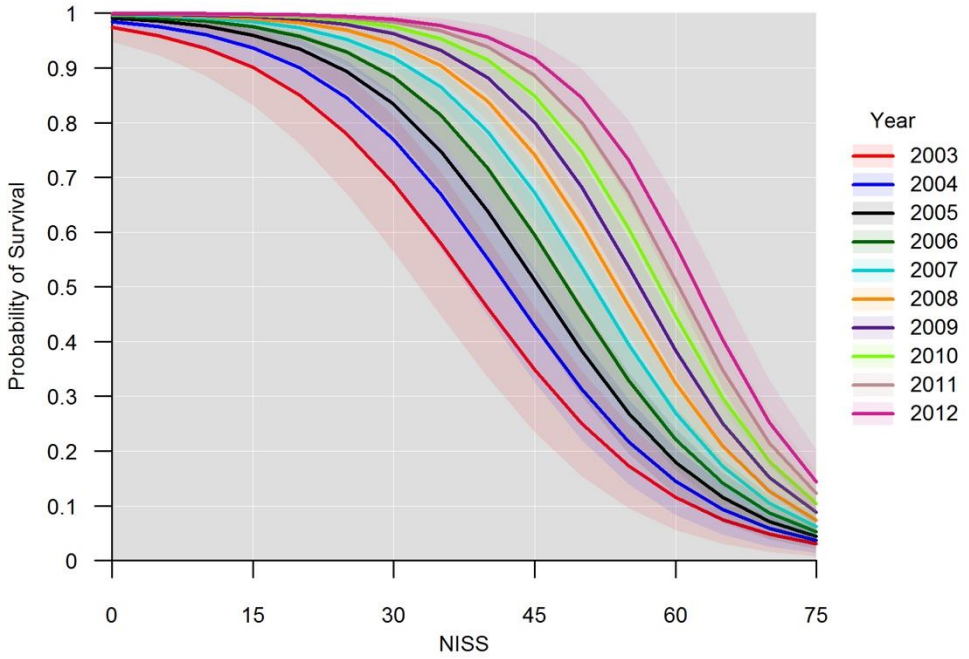
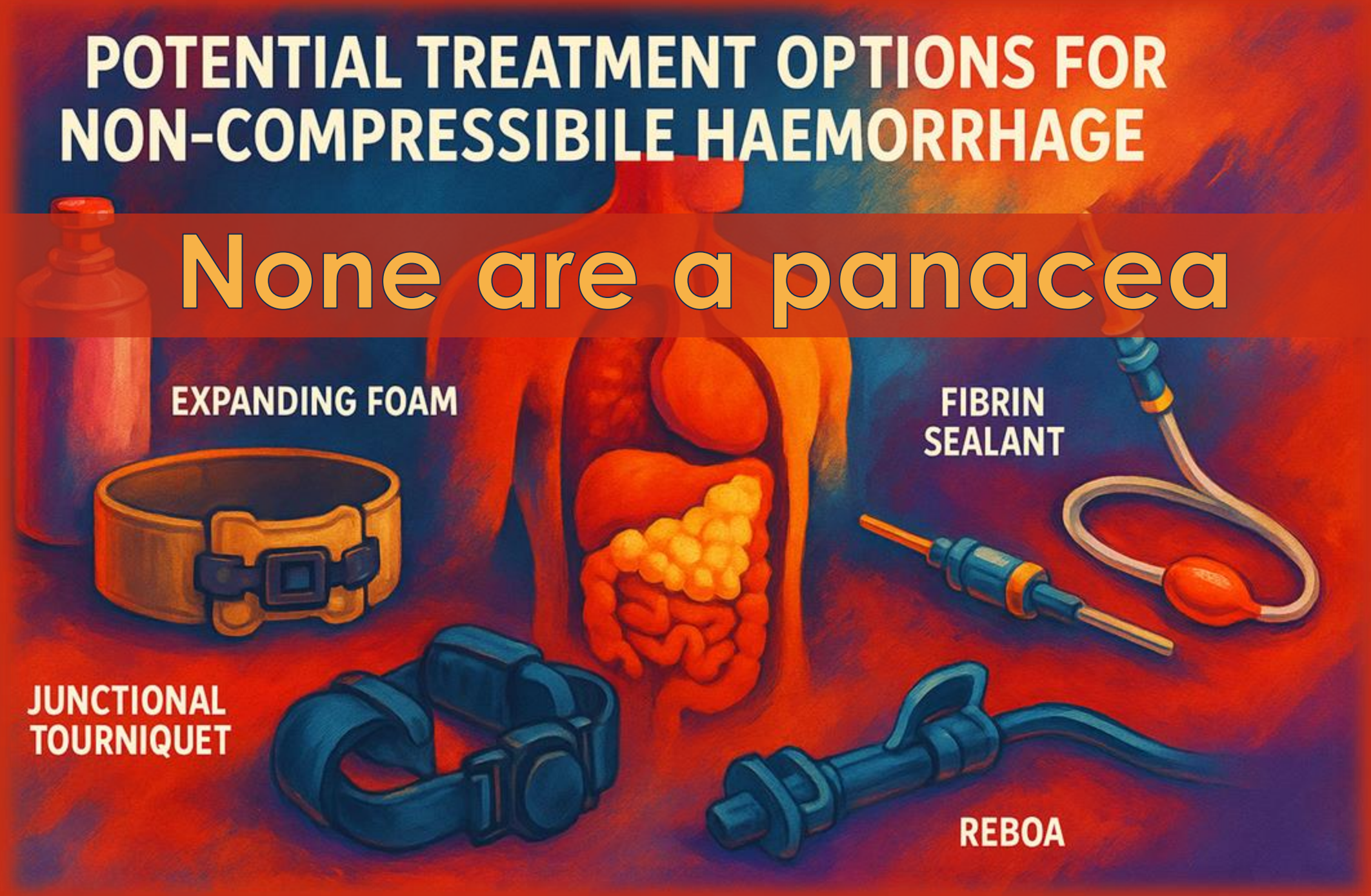
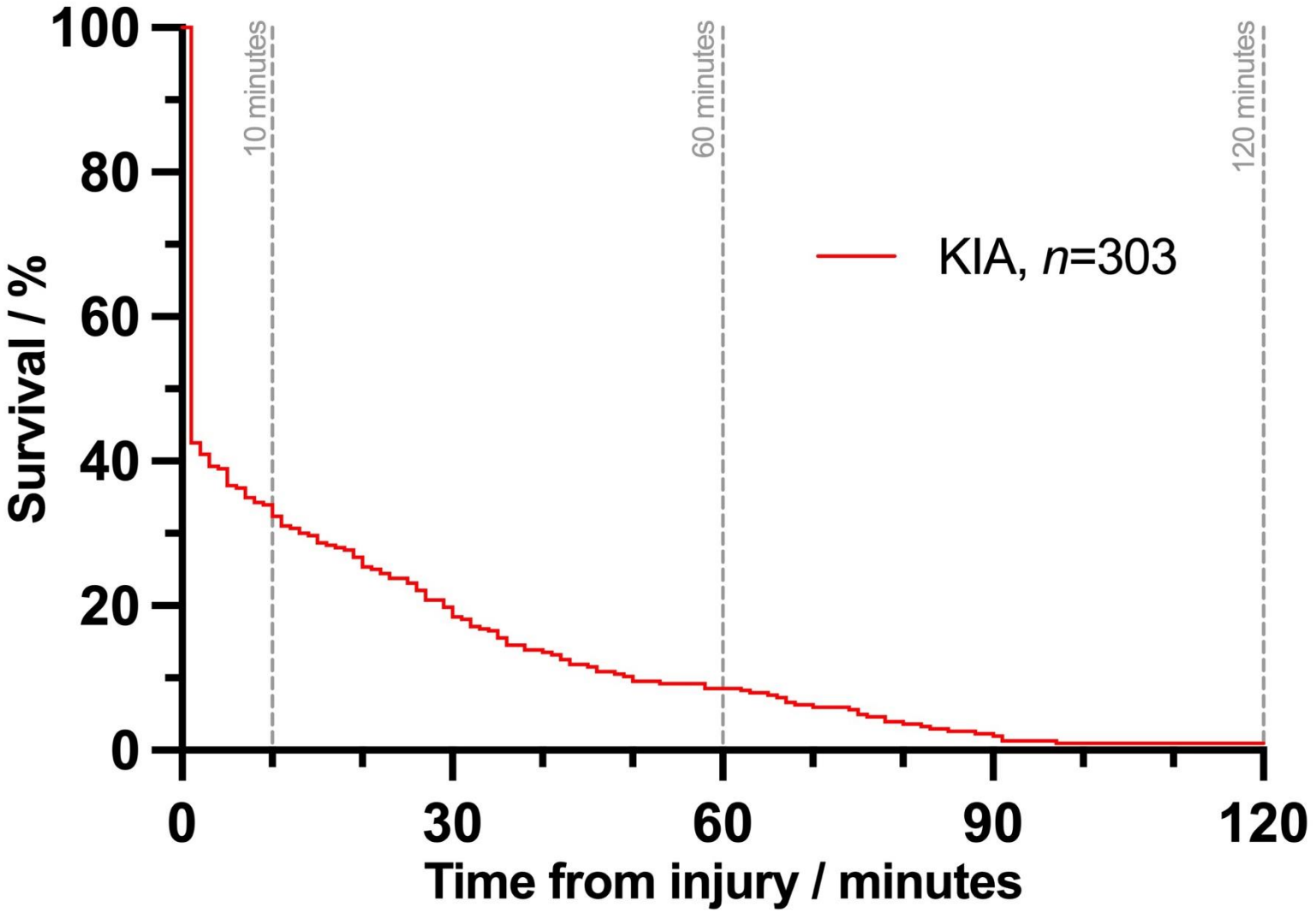


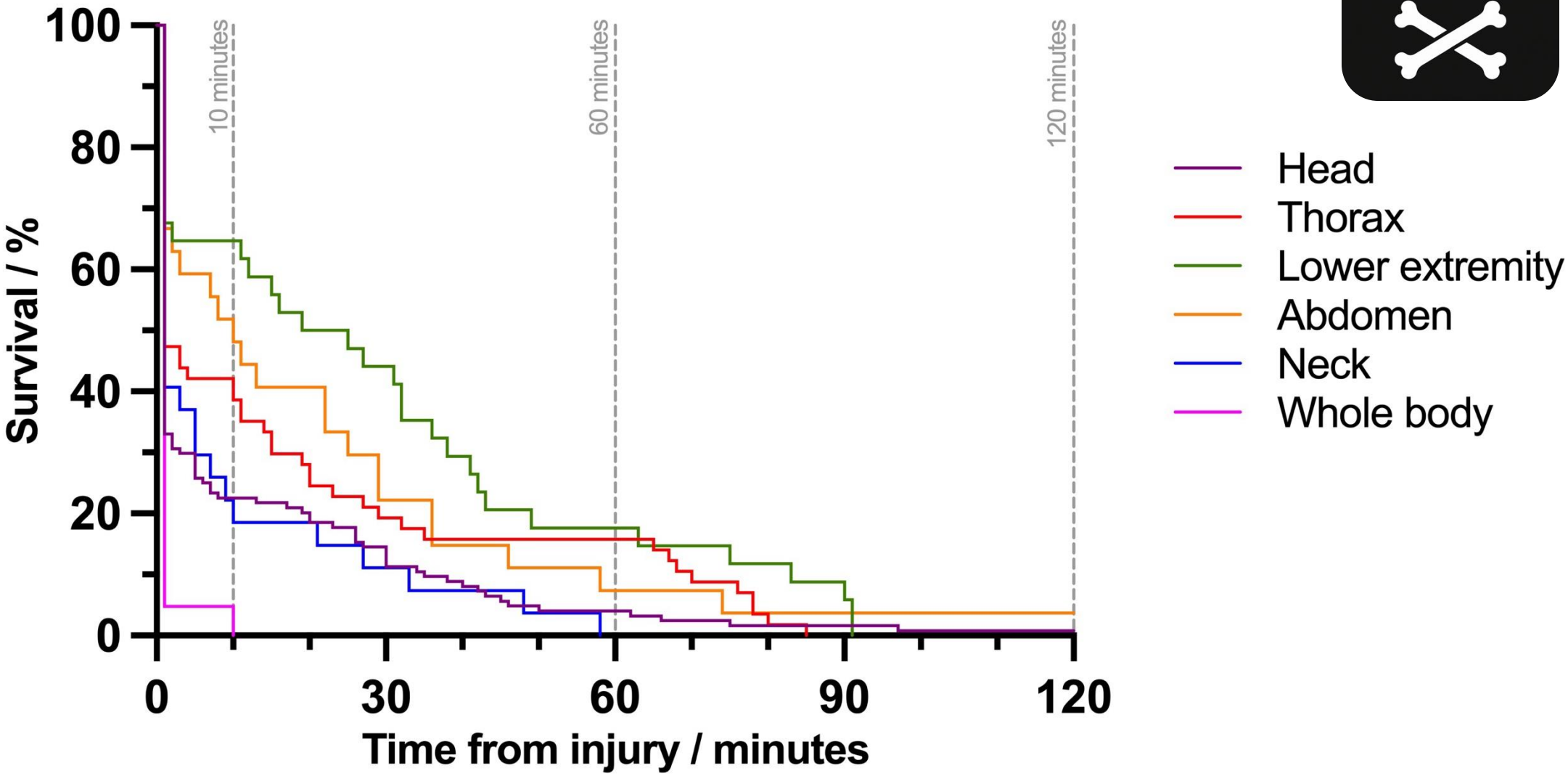


Morrison JJ, *et al*. Injury pattern and mortality of noncompressible torso hemorrhage in UK combat casualties. *J Trauma* 2013.


POTENTIAL TREATMENT OPTIONS FOR
NON-COMPRESSIBILE HAEMORRHAGE
None are a panacea
EXPANDING FOAM
FIBRIN
SEALANT
JUNCTIONAL
TOURNIQUET
REBOA



Webster S, Barnard EBG, Smith JE, Marsden MER, Wright C. Killed in action (KIA): an analysis of military personnel who died of their injuries before reaching a definitive medical treatment facility in Afghanistan (2004-2014). BMJ Mil Health. 2021 Apr;167(2):84-88. doi: 10.1136/bmjmilitary-2020-001490. Epub 2020 Jun 2. PMID: 32487673.



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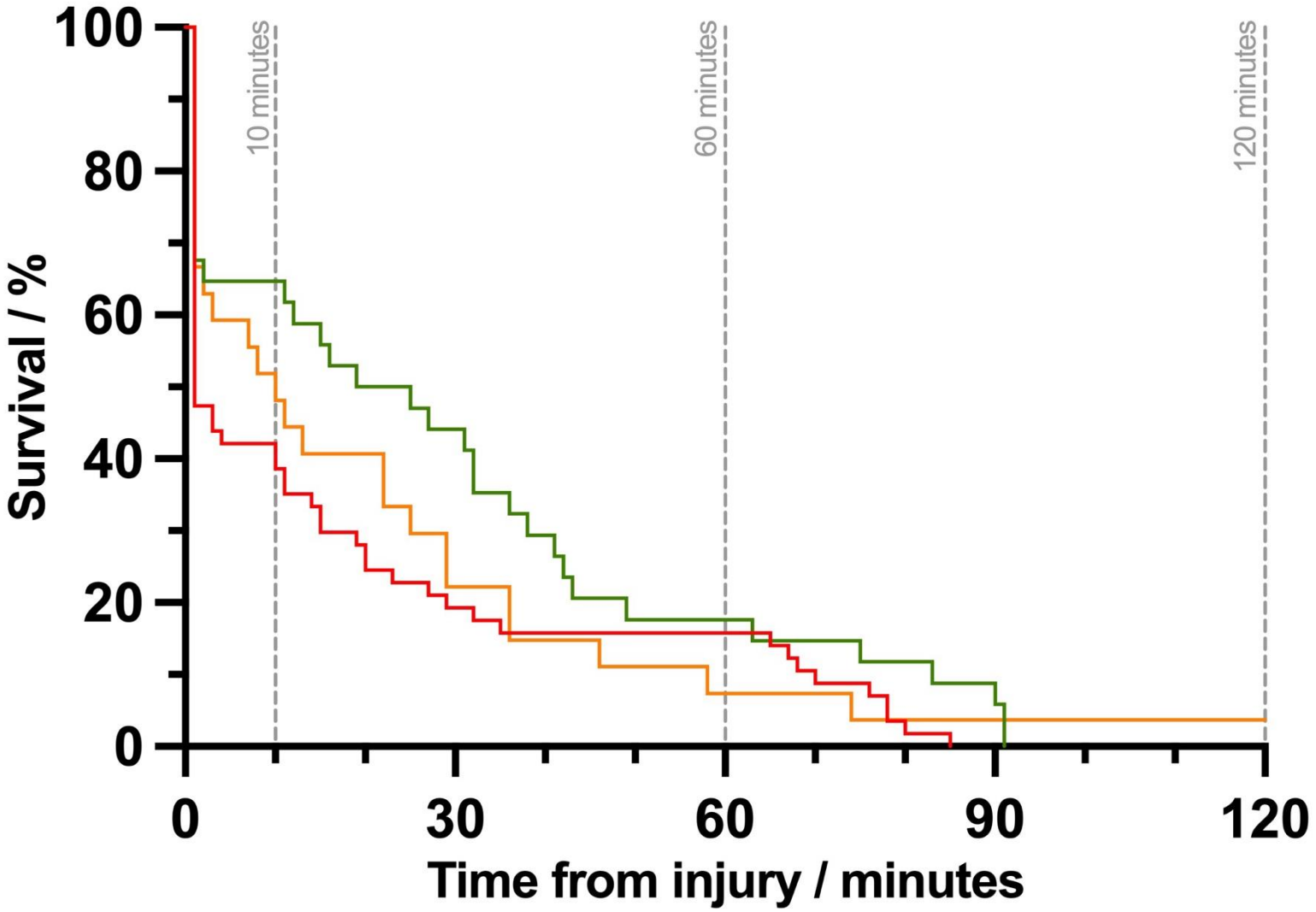

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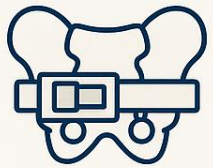
THE TYRANNY
OF TIME
Simple, far-forward intervention

PELVIC BINDERS IN TRAUMA

CLINICAL EFFECTIVENESS



- Reduction in pelvic volume and improved haemodynamics
- Observational studies suggest possible mortality benefit
- Evidence confounded by indication; no RCTs to date

ADVERSE EFFECTS AND LIMITATIONS

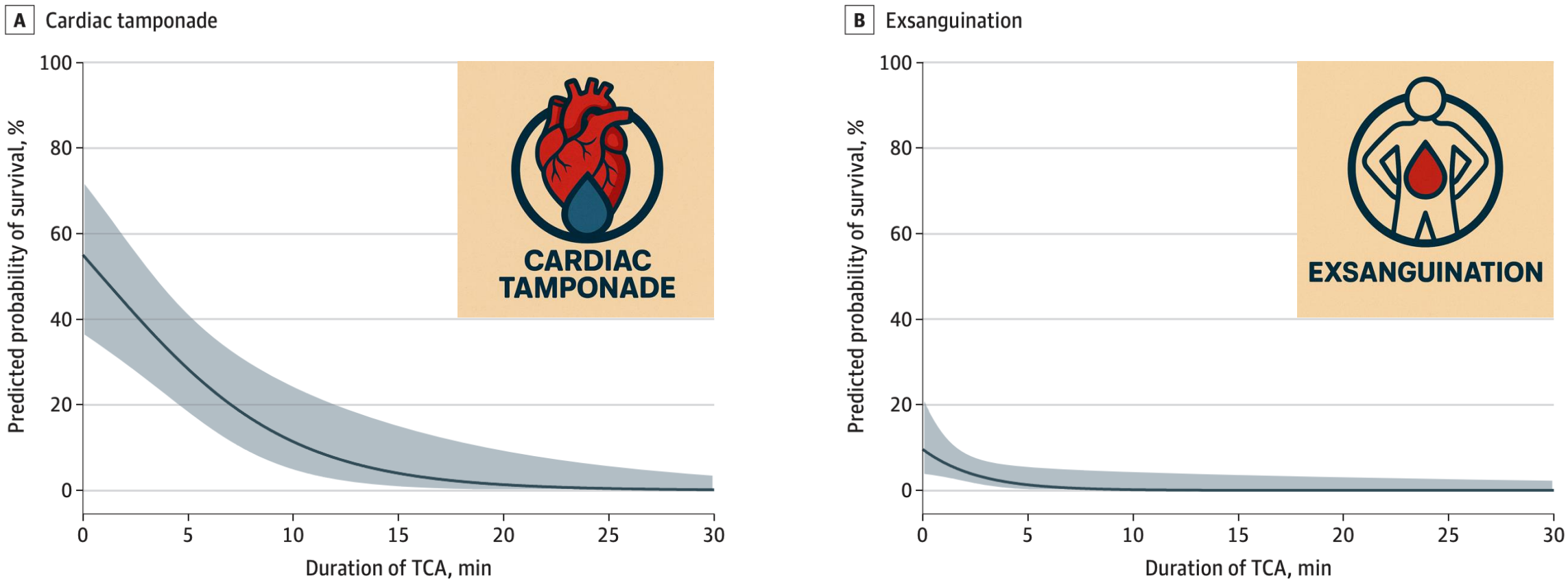
- Missed injuries and malreduction
- Skin breakdown with prolonged use
- Iatrogenic damage with misplacement
- Delayed recognition of internal injuries

GUIDELINE RECOMMENDATIONS

- Use in unstable pelvic fracture with shock
- Place over greater trochanters
- Remove once practical

London's Air Ambulance Charity

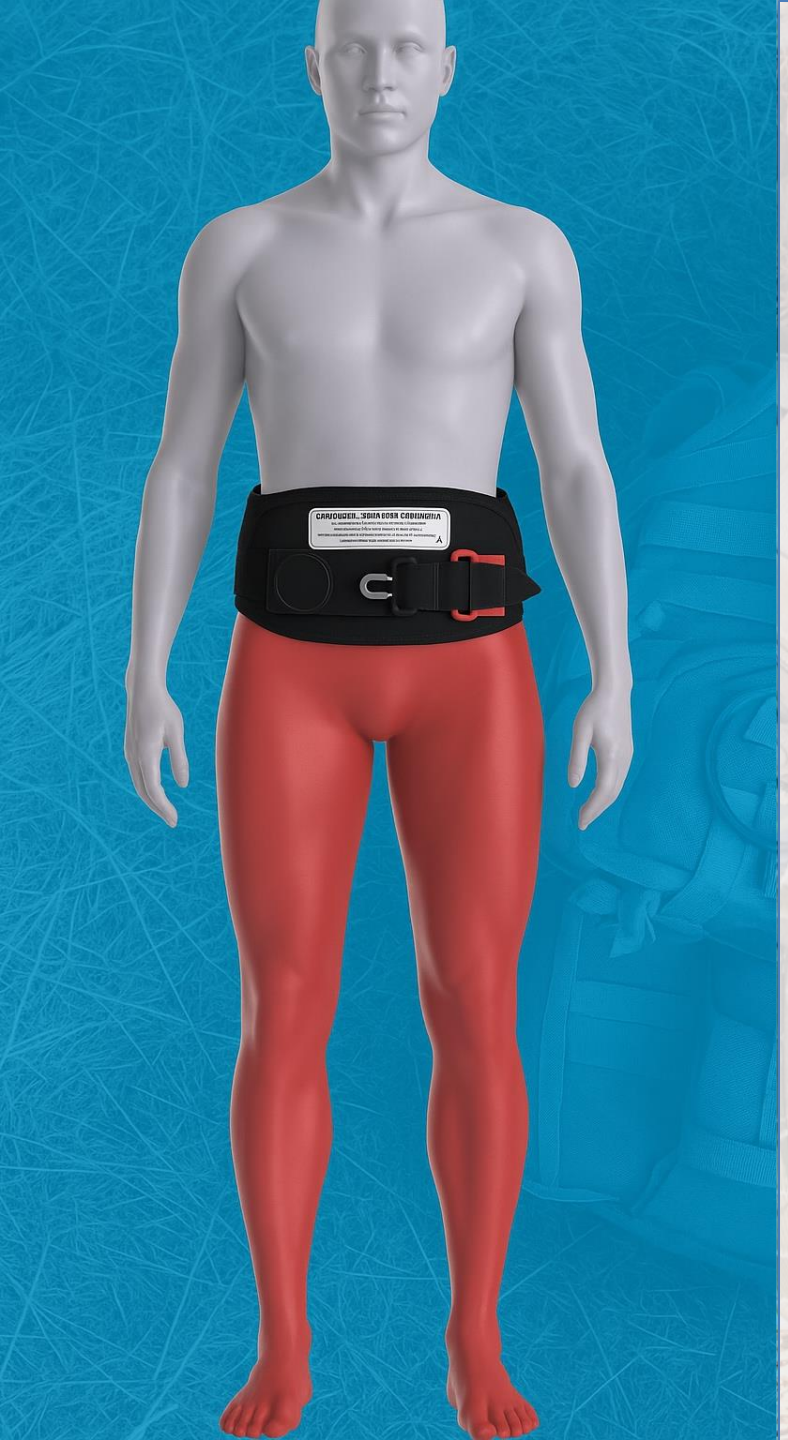
Figure 2. Predicted Probability of Survival After Traumatic Cardiac Arrest (TCA) Caused by (A) Cardiac Tamponade and (B) Exsanguination According to the Duration of TCA in Minutes

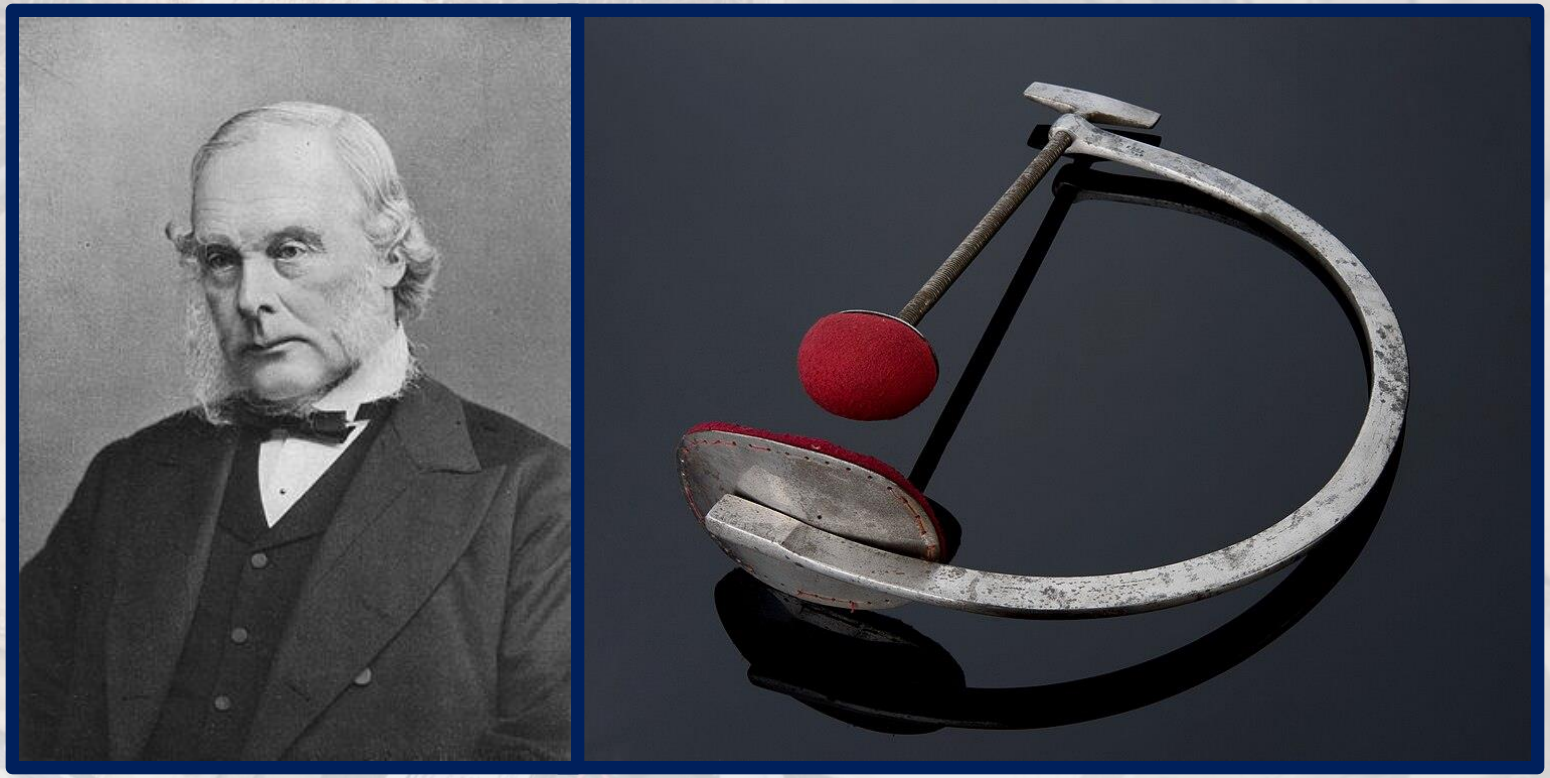


The predicted probability of survival was calculated using simple logistic regression with the duration of TCA in minutes as the independent variable and a binary outcome of survived vs died as the dependent variable. The shading indicates the 95% asymptotic confidence bands of the true curve.

Perkins ZB, Greenhalgh R, Ter Avest E, et al. Prehospital Resuscitative Thoracotomy for Traumatic Cardiac Arrest. JAMA Surg. 2025 Feb 26;160(4):432–40. doi: 10.1001/jamasurg.2024.7245


PULL TO TIGHTEN





This tourniquet was used during surgery to compress the abdominal aorta. It was invented by **Joseph Lister** (1827-1912), the pioneer of antisepsis, while he was working at the Royal Infirmary Glasgow.

Lister **abandoned the tourniquet** after a number of modifications because it **damaged other internal organs**, such as the bowel, when in use.

compressionworks

2011 2012 2013 2014 2017 2018 2020 2021 2022

AAT

AAJT-S

AAJT-S Gen2

compressionworks

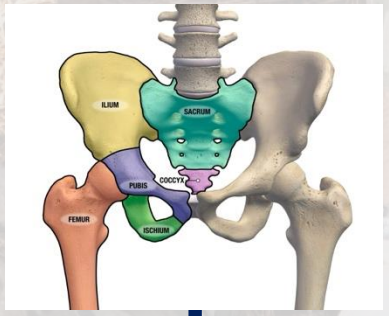
2011 2012 2013 2014 2017 2018 2020 2021 2022

AAT AAJT-S AAJT-S Gen2

compressionworks

2011 2012 2013 2014 2017 2018 2020 2021 2022

AAT AAJT-S AAJT-S Gen2



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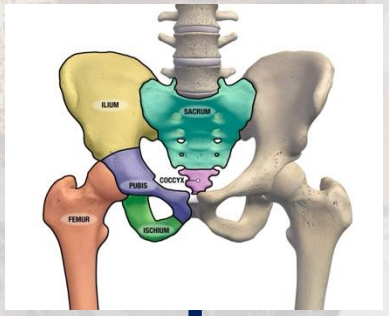
AAT AAJT-S AAJT-S Gen2



compressionworks

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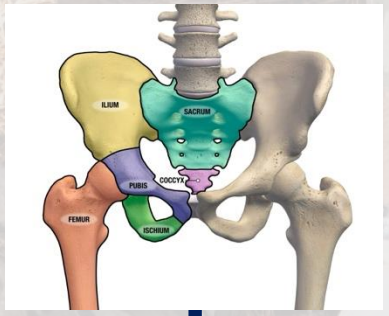
AAT AAJT-S AAJT-S Gen2



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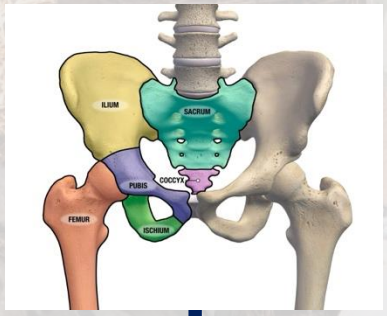

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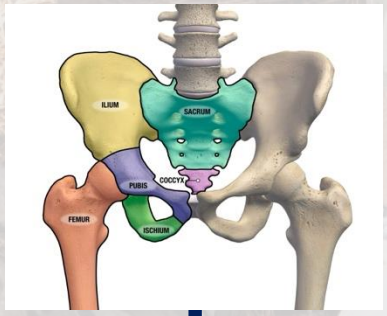
AAJT-S

AAJT-S Gen2



compressionworks

UNITED STATES ARMY INSTITUTE OF SURGICAL RESEARCH

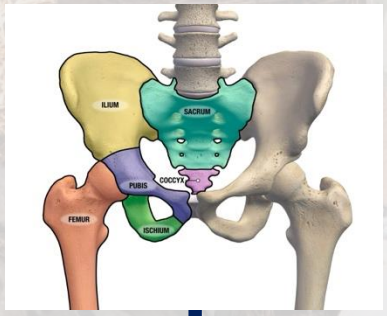
TACTICAL COMBAT CASUALTY CARE
PREHOSPITAL TRAUMA LIFE SUPPORT

2011 2012 2013 2014 2017 2018 2020 2021 2022

AAT

AAJT-S

AAJT-S Gen2



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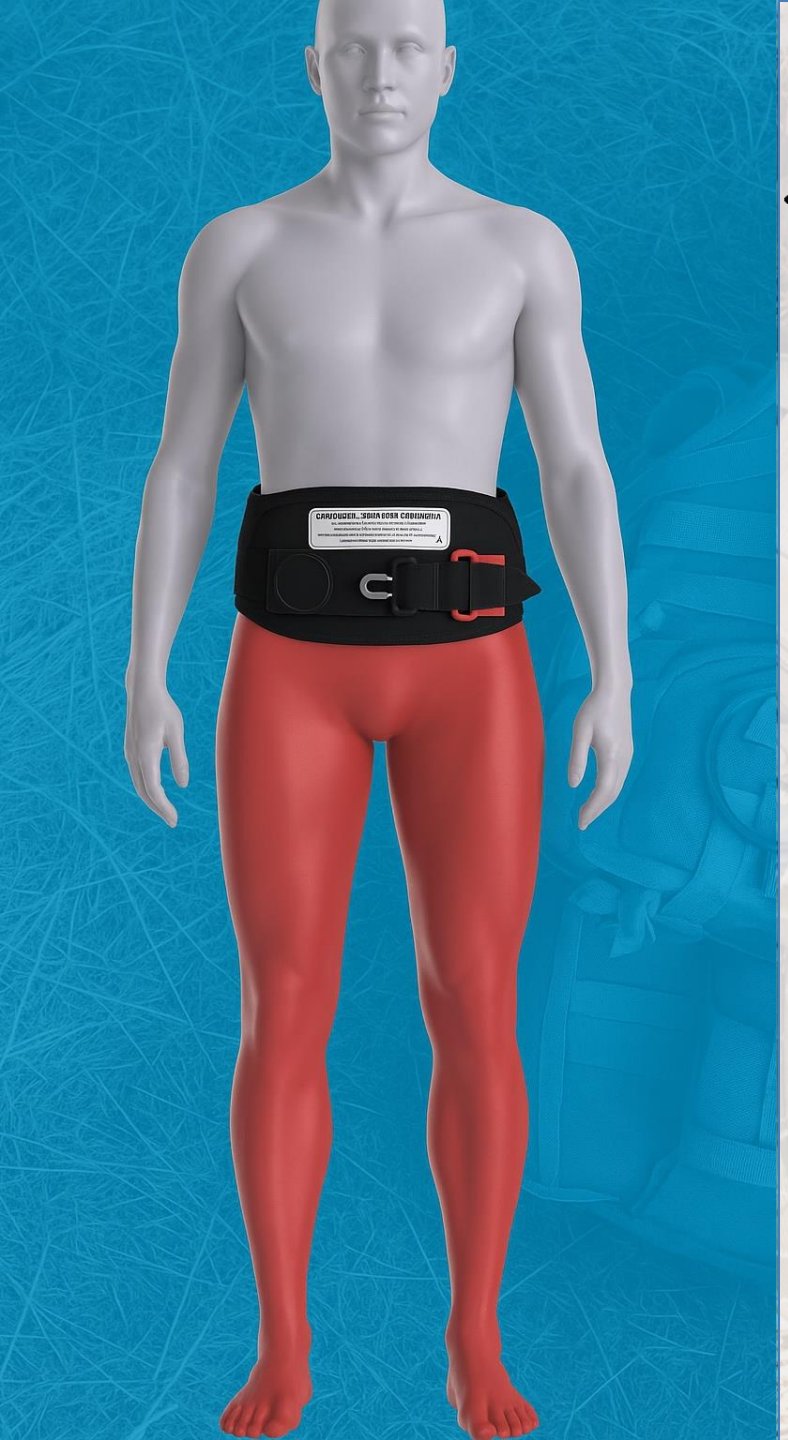
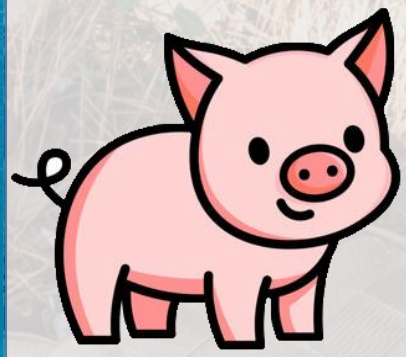
2011 2012 2013 2014 2017 2018 2020 2021 2022

AAT AAJT-S AAJT-S Gen2





160 swine

7 animal studies

Haem / liver injury / pelvic injury

Flow occlusion

Increased MAP & SVR

Better survival cf no Rx

Comparisons with fluid, REBOA, pelvic packing

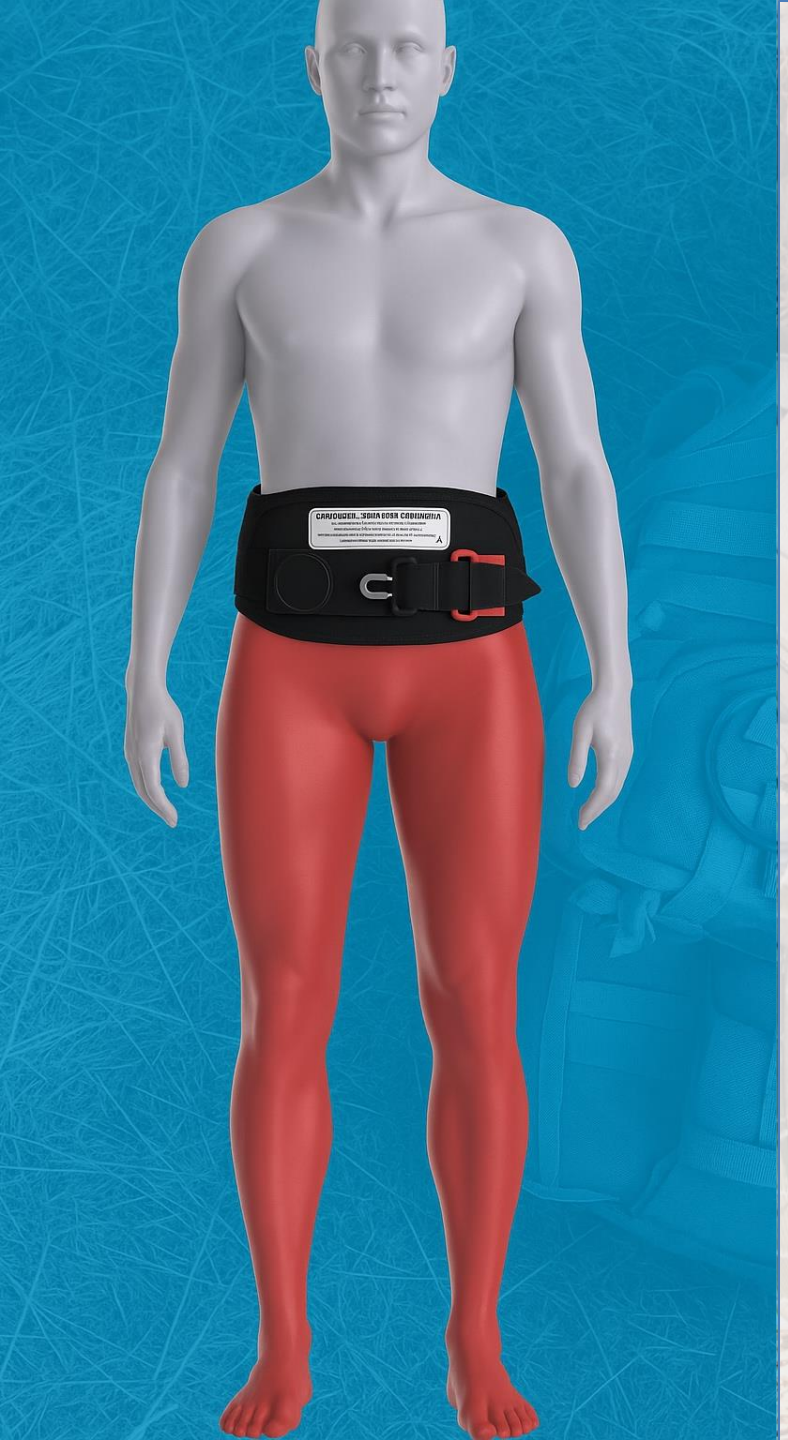
Ischaemia-reperfusion

Compression complications - associated with duration

IVC thrombus

Ventilatory failure

Consensus that 60-minute application is safe



5 human studies

75 humans / 251 applications

Healthy human volunteer

100% male

Quick, easy to apply

Minimal training burden

Flow cessation / return

Cf SJT, CRoC, JETT

Pain+++ (prevented flow occlusion)

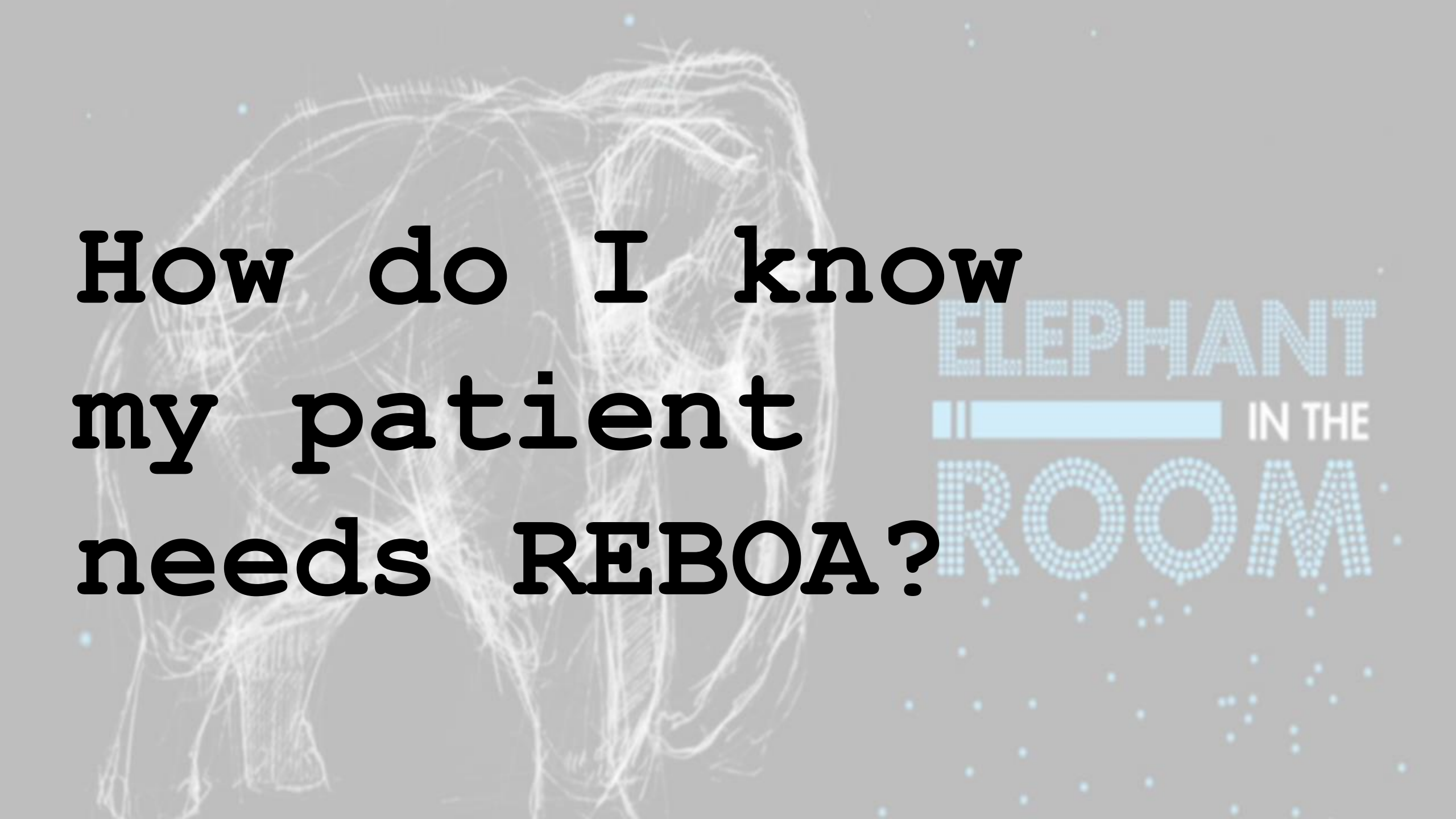
Bladder failure

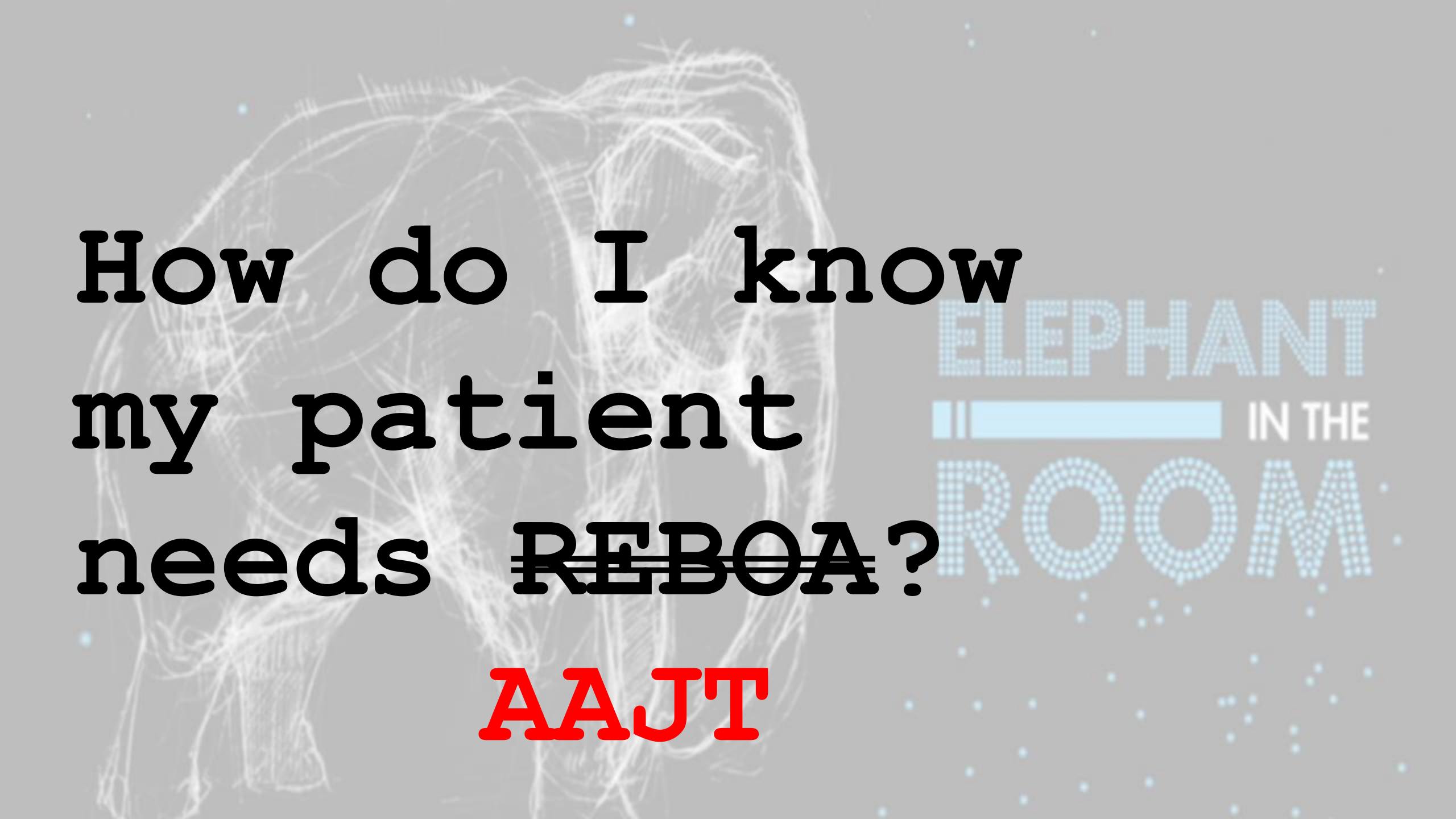
Brief applications

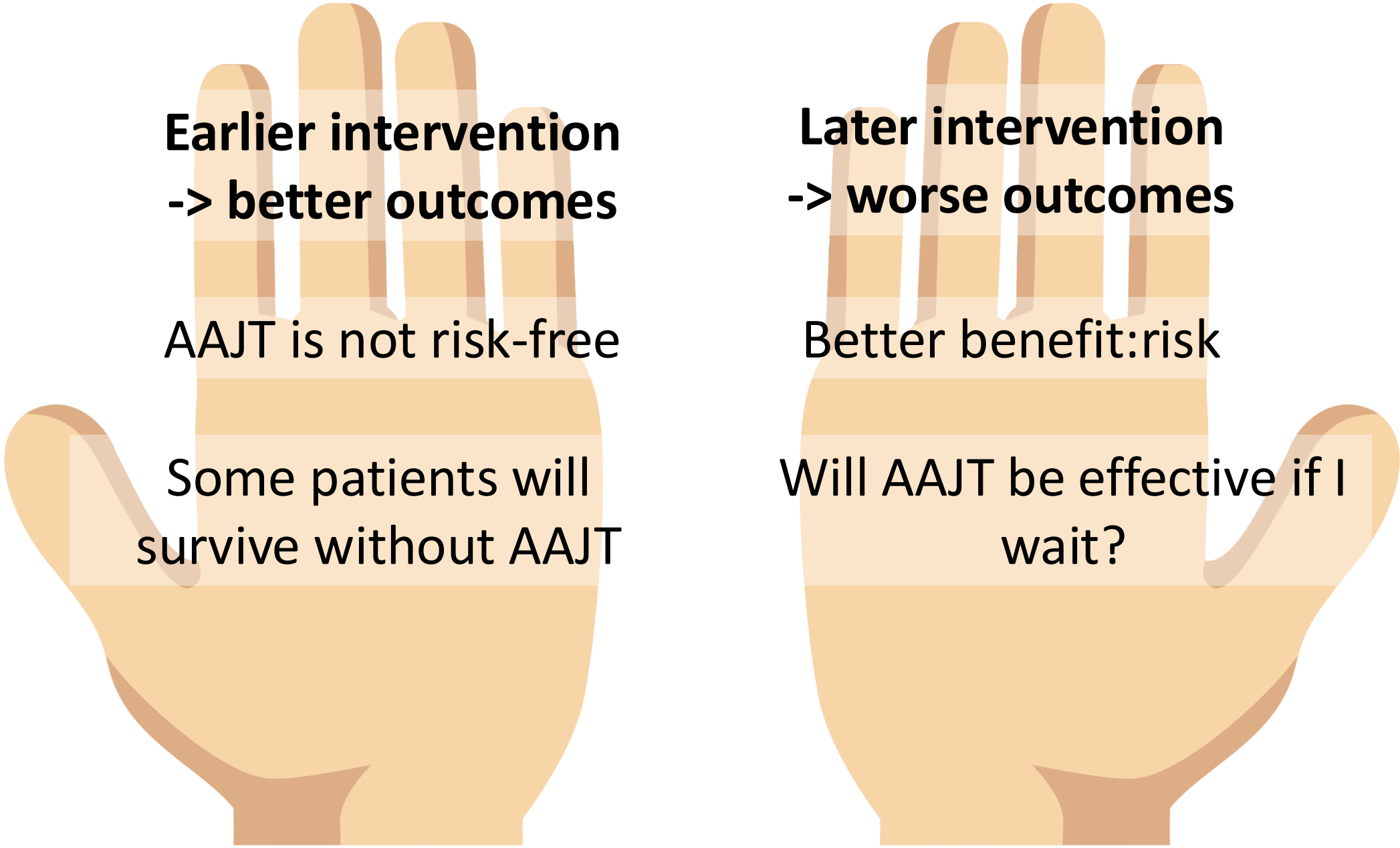
Healthy

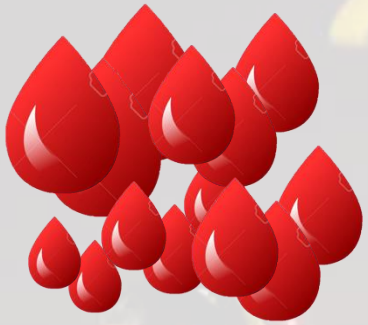
Permissive setting

Data are limited


How do I know my patient needs REBOA?
ELEPHANT IN THE ROOM


How do I know my patient needs ~~REBOA~~?
AAJT
ELEPHANT IN THE ROOM


Earlier intervention
-> better outcomes
AAJT is not risk-free
Some patients will survive without AAJT
Later intervention
-> worse outcomes
Better benefit:risk
Will AAJT be effective if I wait?



n=29

141 seconds

17/29 = 59%

TCA

n=50

300 seconds***

5/50 = 10%***

Brenner M, et al. Use of Resuscitative Endovascular Balloon Occlusion of the Aorta for Proximal Aortic Control in Patients With Severe Hemorrhage and Arrest. JAMA Surg 2017. doi:10.1001/jamasurg.2017.3549

RESUSCITATION 156 (2020) 210 –214

Available online at www.sciencedirect.com

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

Short paper

First experience with the abdominal aortic and junctional tourniquet in prehospital traumatic cardiac arrest

Fay Balian[a,b], *Alan A. Garner*[c,d,*], *Andrew Weatherall*[a,e,f], *Anna Lee*[g]

[a] CareFlight NSW, Redbank Rd, Westmead, NSW 2145, Australia
[b] Royal Prince Alfred Hospital, Sydney, Australia
[c] Trauma Department, Nepean Hospital, Derby St, Kingswood, NSW 2747, Australia
[d] Universityof Sydney, Australia
[e] Division of Child and Adolescent Health, The University of Sydney, Australia
[f] The Children's Hospital at Westmead, Australia
[g] Department of Anaesthesia and Intensive Care, The Chinese University of Hong Kong, Shatin, New Territories, Hong Kong, China

Abstract

Introduction: The Abdominal Aortic and Junctional Tourniquet (AAJT) increased systemic vascular resistance, mean arterial pressure, carotid blood flow and rate of return of spontaneous circulation (ROSC) in animals with hypovolaemic traumatic cardiac arrest (TCA). The objective of this study was to report the first experience of the use of the AAJT as part of a pre-hospital TCA algorithm.

Methods: This is a descriptive case series of the use of the AAJT in patients with TCA in a civilian physician-led pre-hospital trauma service in Sydney, Australia between June 2015 to August 2019. Cases were identified and data sourced from routinely collected data sets within the retrieval service.

Results: During the study, 44 TCAs were attended, 22 with AAJT application. Mean time (standard deviation) to AAJT application since last signs of life was 16 (9) min. Eighteen (16 males, 2 females) patients, with median age (interquartile range) of 40 (25–58) years, were included for analysis. Seventeen patients (94%) had blunt trauma. Sixteen patients (89%) were in TCA at the time of service contact, 11 (61%) had a change in electrical activity, 4 (22%) had ROSC, and of the 6 with documented end-tidal carbon dioxide, the mean rise was 24.0 mmHg (95% CI 12.6–35.4) (P = 0.003). Three patients (17%) had sustained ROSC on arrival to the Emergency Department. No patients survived to hospital discharge.

Conclusion: Physiological changes were demonstrated but there were no survivors. Further research focusing on faster application times may be associated with improved outcomes.

Keywords: Traumatic cardiac arrest, Abdominal aortic and junctional tourniquet, Prehospital

Introduction

Pre-hospital resuscitation of traumatic cardiac arrest (TCA) is focused on the reversible causes: haemorrhage, hypoxia, hypovolaemia, tamponade and tension pneumothorax.[1,2] Haemorrhage remains the leading potentially preventable cause of death, particularly non-compressible torso haemorrhage.

Thoracic aortic clamping/compression via thoracotomy is an established intervention in TCA management.[1,2] Manual external compression of the aorta for hypovolaemic arrest has been described in pre-hospital practice, but is difficult to maintain during transport.[3]

* Corresponding author at: Trauma Department, Nepean Hospital, Derby St, Kingswood, NSW 2747, Australia.
E-mail addresses: fay.balian@careflight.org (F. Balian), alan.garner@careflight.org (A.A. Garner), andrew.weatherall@careflight.org (A. Weatherall), annalee@cuhk.edu.hk (A. Lee).

https://doi.org/10.1016/j.resuscitation.2020.09.018
Received 6 May 2020; Received in revised form 22 August 2020; Accepted 4 September 2020

Retrospective case series of TCA patients

2015-2019 Sydney HEMS

44 TCA, AAJT 22; 60-90 seconds to apply

18 patients included, 94% blunt, 89% male

4 ROSC; 3 ROSC to ED; 0% survival to d/c

AAJT feasible & assoc with better vital signs

Earlier application may have been better

6 TCA pts: Bakhmut (2022), Slovyansk (2023)

Prehospital (medics) / FSSS (surgeons)

Prolonged evac, limited resource, TCA

Successful Management of Battlefield Traumatic Cardiac Arrest Using the Abdominal Aortic and Junctional Tourniquet (AAJT)

A Case Series

Dmytro Androshchuk[1]; Andriy Verba, PhD[2]*

ABSTRACT

The Russo-Ukrainian war's prolonged warfare, resource constraints, and extended evacuation times have forced significant adaptations in Ukraine's medical system – including technological advancements and strategic resource placement. This study examined if the Abdominal Aortic and Junctional Tourniquet – Stabilized (AAJT-S) could manage traumatic cardiac arrest (TCA) at forward surgical stabilization sites (FSSS) as an adjunct to damage control surgery. Six patients in severe hypovolemic shock presented at an FSSS during fighting in Bakhmut (July 2022) and Slovyansk (May 2023). Following TCA due to exsanguination, the AAJT-S was applied 2cm below the umbilicus. Cardiopulmonary resuscitation (CPR) and transfusion (blood and/or plasma) were initiated. All six patients were resuscitated. None required vasopressor support post-resuscitation. Five survived to the next level of care. One died awaiting evacuation, and another of wounds after 10 days. Four survived to discharge. Three were followed and neurologically intact, and no death records matched the fourth's name and date of birth at 18 months. Follow-up was limited, but one patient was neurologically intact at one year. The AAJT-S effectively resuscitated TCA patients. It increased mean arterial pressure, focused resuscitative efforts on the upper torso, simplified care, and preserved crucial field resources. An alternative to traditional emergency thoracotomy, AAJT-S could replace or complement resuscitative endovascular balloon occlusion of the aorta in pre-hospital settings, given its ease of application by combat medics. AAJT-S, alongside blood transfusion and CPR, achieved 100% success in return of spontaneous circulation and effectively managed TCA in a wartime FSSS.

KEYWORDS: *traumatic cardiac arrest; hemorrhagic shock; damage control surgery; damage control resuscitation; abdominal aortic and junctional tourniquet – stabilized; AAJT-S; resuscitative endovascular balloon occlusion of the aorta; trauma management; emergency thoracotomy*

Introduction

Prolonged warfare during the Russo-Ukrainian war beginning in 2014, including the armed occupation of Ukrainian territories, has forced significant changes to the Ukrainian medical system. Limited resources, a lack of clear air superiority, a constant threat of bombardment, artillery fire, and drone use have extended evacuation times from the front lines to higher levels of emergency care at Role 1 and Role 2.

The extended evacuation timelines have been mitigated to some degree by technological advancements in medical care and the placement of surgical resources closer to the front lines and the forward edge of the battle area. The ability to control massive hemorrhage is now required everywhere on the battlefield. Control of massive hemorrhage is now required at every stage, from point of wounding to forward surgical stabilization sites. Early observations of the war suggest these changes may have reduced the immediate mortality of battlefield injuries by up to 30% (unpublished observations by our team).

Hemorrhage risks traumatic cardiac arrest (TCA), but even in-hospital civilian TCA demonstrates very poor outcomes. Traditional management techniques include emergency thoracotomy with aortic clamping, resuscitative endovascular balloon occlusion of the aorta (REBOA), and massive transfusion protocols, all labor- and equipment-intensive. Emergency thoracotomy also increases patient risk, even when a return of spontaneous circulation (ROSC) is achieved.

In contrast, the Abdominal Aortic and Junctional Tourniquet – Stabilized (AAJT-S) has been shown to control bleeding in the pelvis and the junctional regions of the groin and axilla by stopping blood flow.[1,2,3] It had been incorporated as an adjunct hemorrhage control measure at the 59th MMH forward stabilization sites when damage control surgery (DCS) was initiated. Research from U.S. and Australian researchers suggest AAJT-S could now play a role in the management of TCA.[4,5] The use of tourniquets to increase vascular resistance has been shown to generate significantly greater coronary perfusion pressure, end-tidal carbon dioxide, and carotid blood flow.[6]

Surgeons at a surgical stabilization site (Role 2) in Ukraine during fighting in Bakhmut (July 2022) and Slovyansk (May 2023) explored the use of the AAJT-S as an alternative to traditional thoracotomy for the management of TCA. AAJT-S use was hypothesized to avoid emergency thoracotomy, simplify care, and preserve the already limited resources that these sites use to treat casualties. Thus, this article examines the use of the AAJT-S (Compression Works, Inc., Birmingham, AL) in

*Correspondence to croushorn@gmail.com
[1]**Dmytro Androshchuk** is a Senior Lieutenant affiliated with the Medical Service of the Ukrainian Armed Forces, a vascular surgeon, and a Senior Officer of the Frontline Surgical Group. [2]**Dr. Andriy Verba** is a Professor General Surgeon and Major General in the Ukrainian Military Medical Service.

R1: GSW sh… pelvis, hip → TCA. D… n AAJT?

Option 1

Not sure

Option 3

No

6 TCA pts: Bakhmut (2022), Slovyansk (2023)

Prehospital (medics) / FSSS (surgeons)

Prolonged evac, limited resource, TCA

Combination of GSW, frag, mine

3 prehospital / 3 at the FSSS

All patients had a ROSC

5 survived to R3 / 4 to discharge

Successful Management of Battlefield Traumatic Cardiac Arrest Using the Abdominal Aortic and Junctional Tourniquet (AAJT)

A Case Series

Dmytro Androshchuk[1]; Andriy Verba, PhD[2]*

ABSTRACT

The Russo-Ukrainian war's prolonged warfare, resource constraints, and extended evacuation times have forced significant adaptations in Ukraine's medical system – including technological advancements and strategic resource placement. This study examined if the Abdominal Aortic and Junctional Tourniquet – Stabilized (AAJT-S) could manage traumatic cardiac arrest (TCA) at forward surgical stabilization sites (FSSS) as an adjunct to damage control surgery. Six patients in severe hypovolemic shock presented at an FSSS during fighting in Bakhmut (July 2022) and Slovyansk (May 2023). Following TCA due to exsanguination, the AAJT-S was applied 2cm below the umbilicus. Cardiopulmonary resuscitation (CPR) and transfusion (blood and/or plasma) were initiated. All six patients were resuscitated. None required vasopressor support post-resuscitation. Five survived to the next level of care. One died awaiting evacuation, and another of wounds after 10 days. Four survived to discharge. Three were followed and neurologically intact, and no death records matched the fourth's name and date of birth at 18 months. Follow-up was limited, but one patient was neurologically intact at one year. The AAJT-S effectively resuscitated TCA patients. It increased mean arterial pressure, focused resuscitative efforts on the upper torso, simplified care, and preserved crucial field resources. An alternative to traditional emergency thoracotomy, AAJT-S could replace or complement resuscitative endovascular balloon occlusion of the aorta in pre-hospital settings, given its ease of application by combat medics. AAJT-S, alongside blood transfusion and CPR, achieved 100% success in return of spontaneous circulation and effectively managed TCA in a wartime FSSS.

KEYWORDS: *traumatic cardiac arrest; hemorrhagic shock; damage control surgery; damage control resuscitation; abdominal aortic and junctional tourniquet – stabilized; AAJT-S; resuscitative endovascular balloon occlusion of the aorta; trauma management; emergency thoracotomy*

Introduction

Prolonged warfare during the Russo-Ukrainian war beginning in 2014, including the armed occupation of Ukrainian territories, has forced significant changes to the Ukrainian medical system. Limited resources, a lack of clear air superiority, a constant threat of bombardment, artillery fire, and drone use have extended evacuation times from the front lines to higher levels of emergency care at Role 1 and Role 2.

The extended evacuation timelines have been mitigated to some degree by technological advancements in medical care and the placement of surgical resources closer to the front lines and the forward edge of the battle area. The ability to control massive hemorrhage is now required everywhere on the battlefield. Control of massive hemorrhage is now required at every stage, from point of wounding to forward surgical stabilization sites. Early observations of the war suggest these changes may have reduced the immediate mortality of battlefield injuries by up to 30% (unpublished observations by our team).

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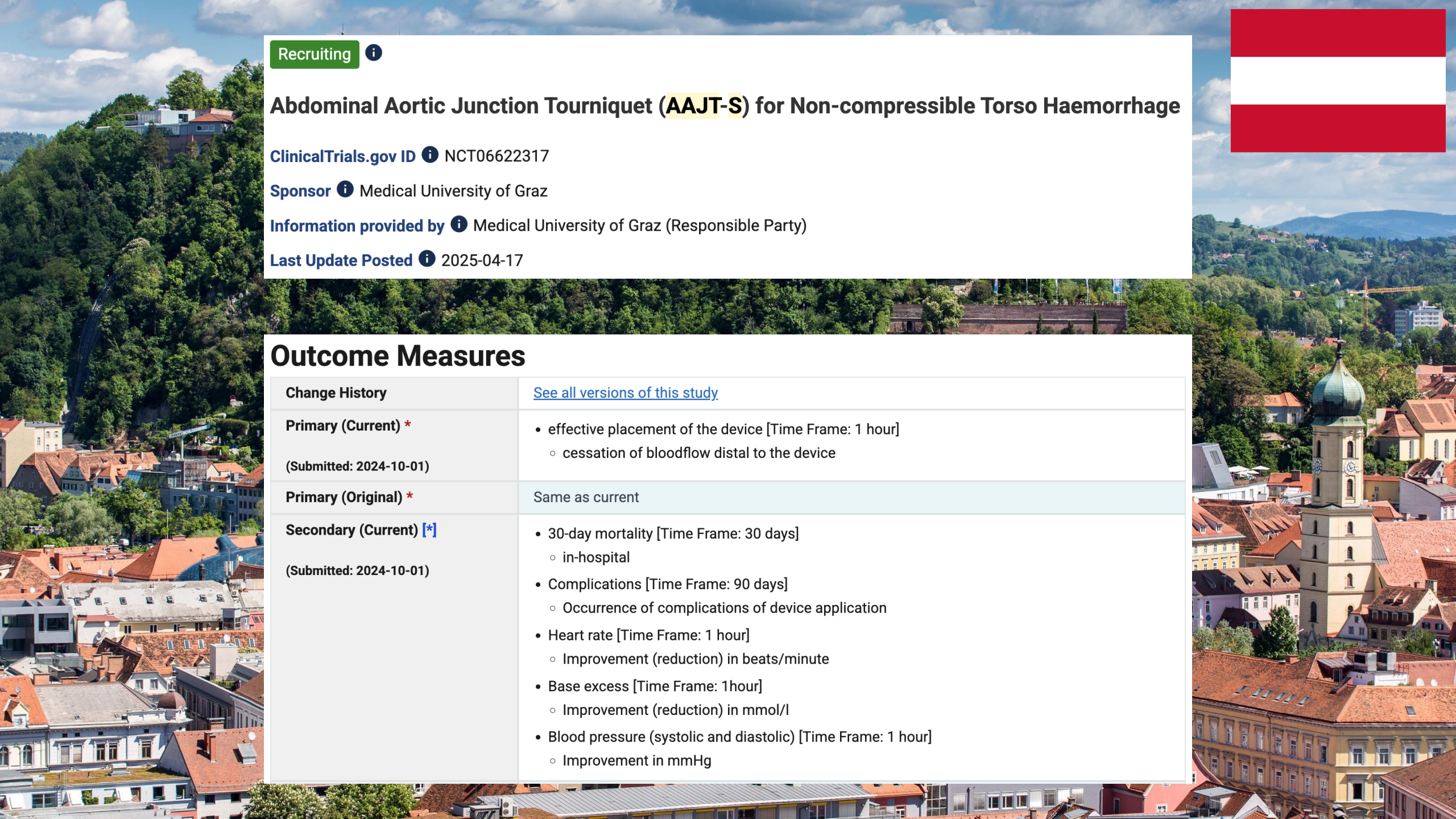


Recruiting

Abdominal Aortic Junction Tourniquet (AAJT-S) for Non-compressible Torso Haemorrhage

ClinicalTrials.gov ID NCT06622317

Sponsor Medical University of Graz

Information provided by Medical University of Graz (Responsible Party)

Last Update Posted 2025-04-17

Outcome Measures

Change History	See all versions of this study
Primary (Current) * **(Submitted: 2024-10-01)**	• effective placement of the device [Time Frame: 1 hour] ◦ cessation of bloodflow distal to the device
Primary (Original) *	Same as current

Secondary (Current) [*]
 (Submitted: 2024-10-01)
	• 30-day mortality [Time Frame: 30 days]
	  ◦ in-hospital
	• Complications [Time Frame: 90 days]
	  ◦ Occurrence of complications of device application
	• Heart rate [Time Frame: 1 hour]
	  ◦ Improvement (reduction) in beats/minute
	• Base excess [Time Frame: 1hour]
	  ◦ Improvement (reduction) in mmol/l
	• Blood pressure (systolic and diastolic) [Time Frame: 1 hour]
	  ◦ Improvement in mmHg

OCCLUDER

OUT OF HOSPITAL CONTROL OF CRITICAL LIFE-THREATENING UNCOMPRESSIBLE HAEMORRHAGE DUE TO TRAUMA - A FEASIBILITY EVALUATION OF RESUSCITATION

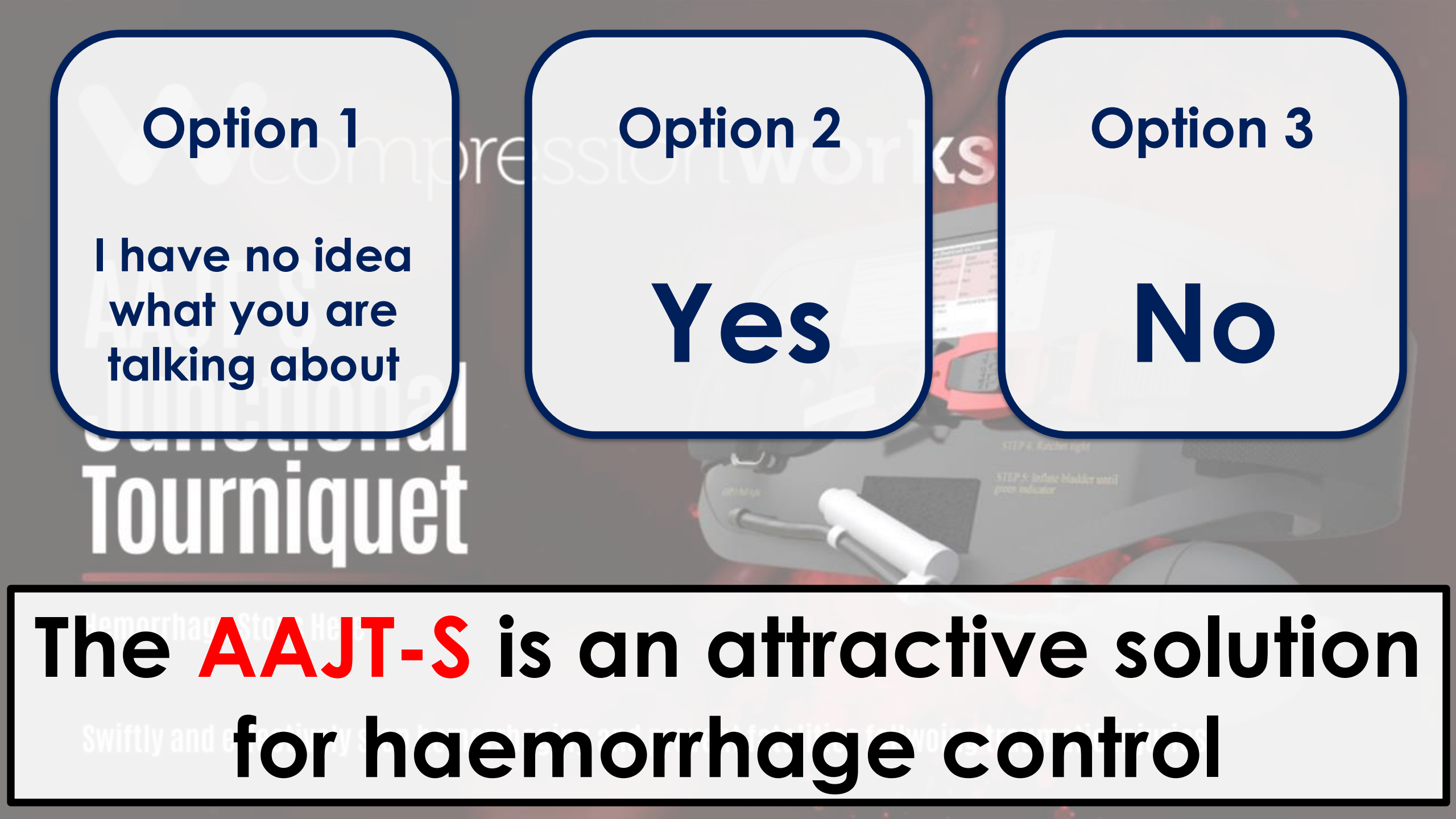
AMBULANCE SERVICE & HELICOPTER EMS

DEPLOYMENT OF AAJT-S DEVICE

OBSERVATION OF RESPONSE

CAPTURE OF OUTCOME VARIABLES & EVENTS

Option 1	Option 2	Option 3
I have no idea what you are talking about	**Yes**	**No**



The AAJT-S is an attractive solution for haemorrhage control

THE ABDOMINAL AORTIC & JUNCTIONAL TOURNIQUET

Innovation at the edge of indication

Surg Capt Ed Barnard
Defence Professor of Emergency Medicine

edward.barnard@nhs.net

+44 (0) 7946 021207

@DefProfEM

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tinyurl.com/THOR25-AAJT