Traumatic Cardiac Arrest: An Outcome Predictors Approach

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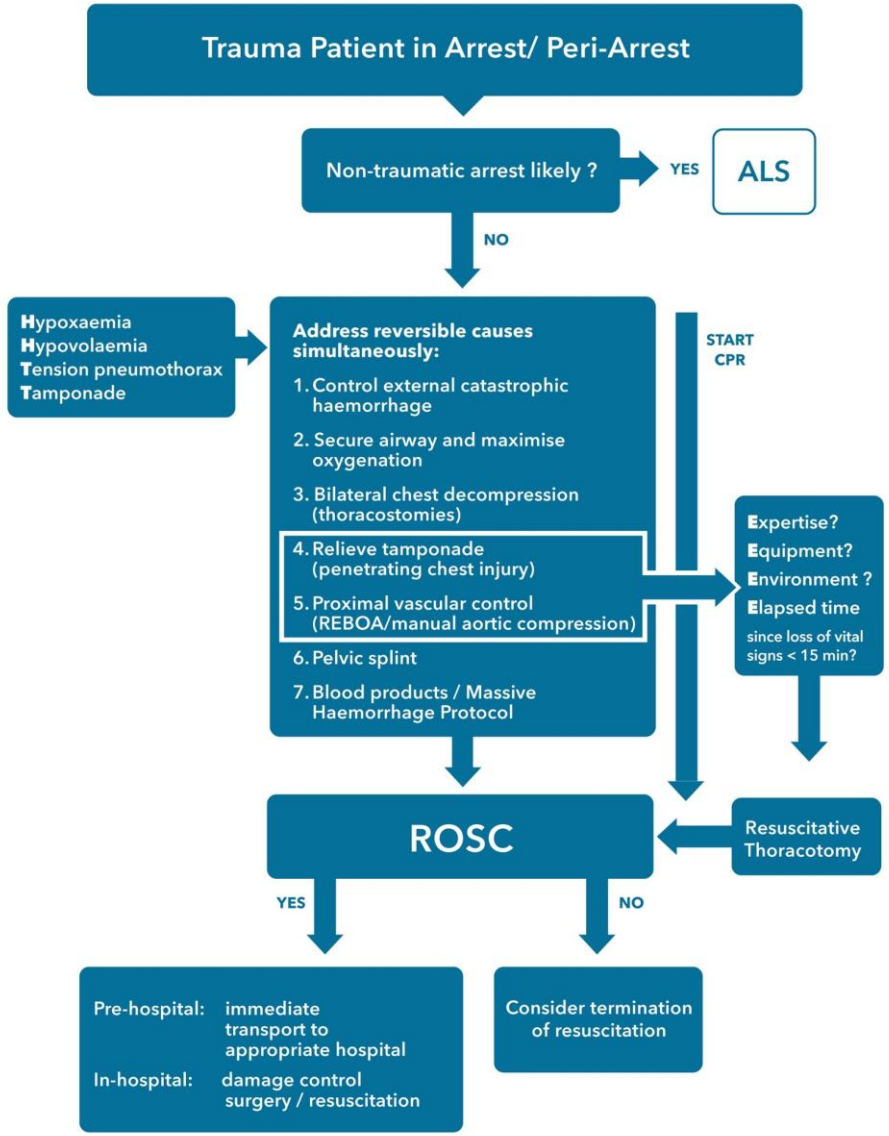
Trauma Staff Specialist

Royal Hobart Hospital

TRAUMA TASMANIA

TRAUMATIC CARDIAC ARREST/ PERI-ARREST ALGORITHM

EUROPEAN RESUSCITATION COUNCIL



Guideline 11.10.1 Management of Cardiac Arrest due to Trauma

8.0 | Conventional Basic and Advanced Life Support

In cardiac arrest due to trauma, all of the interventions aimed at addressing underlying causes take priority over chest compressions, defibrillation and adrenaline. However, if there are sufficient resources available and there is no interference with essential procedures, conventional CPR can occur simultaneously. The effectiveness of conventional CPR will depend on correcting the causes of the cardiac arrest.


DID IT WORK?

CLINICAL PAPER · Volume 165, P8-13, August 2021

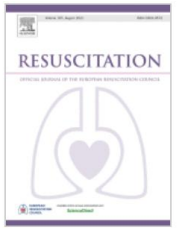
Acting on the potentially reversible causes of traumatic cardiac arrest: Possible but not sufficient

Dominique Savary [a,b] · Delphine Douillet [a] · François Morin [a] · ... · Bruno Carneiro [a] · Marc Fadel [b] · Alexis Descatha [b,e] ...

CLINICAL PAPER · Volume 168, P65-74, November 2021

Survival outcomes in emergency medical services witnessed traumatic out-of-hospital cardiac arrest after the introduction of a trauma-based resuscitation protocol

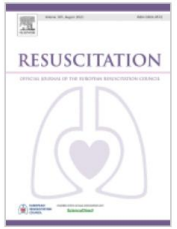
Zainab Alqudah [a,b] · Ziad Nehme [a,c,d] · Brett Williams [a] · Alaa Oteir [a,b] · Karen Smith [a,c,d]



CLINICAL PAPER · Volume 186, 109763, May 2023

Impact of the 2015 European guidelines for resuscitation on traumatic cardiac arrest outcomes and prehospital management: A French nationwide interrupted time-series analysis

Axel Benhamed [a,b] · Eric Mercier [b] · Julie Freyssenge [c,d] · ... · Clement Claustre [c] · Karim Tazarourte [a,d] On behalf of the RéAC investigator [1] ... Show more



Open Access Original Article

DOI: 10.7759/cureus.23194

Algorithm to Improve Resuscitation Outcomes in Patients With Traumatic Out-of-Hospital Cardiac Arrest

Hsin-Min Lee [1], Chia-Ti Wang [1], Chien-Chin Hsu [1], Kuo-Tai Chen [1]

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Cureus
Part of SPRINGER NATURE

ORIGINAL RESEARCH

Outcomes in traumatic cardiac arrest patients who underwent advanced life support

Frances WILLIAMSON, Catherine F LAWTON and Martin WULLSCHLEGER

EMA Emergency Medicine Australasia

Emergency Medicine Australasia (2023) **35**, 205–212


me to my therapist after my therapy session.
the noob 2 days ago
thx it did not work you are the best
Reply

RESUSCITATION 153 (2020) 119 –135

Available online at www.sciencedirect.com

Resuscitation

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

EUROPEAN RESUSCITATION COUNCIL

Review

Pre-arrest and intra-arrest prognostic factors associated with survival following traumatic out-of-hospital cardiac arrest – A systematic review and meta-analysis

Alexandre Tran[a,b,c,], Shannon M. Fernando[c,d], Bram Rochwerg[e,f], Christian Vaillancourt[b,d,g], Kenji Inaba[h], Kwadwo Kyeremanteng[c,g,i], Jerry P. Nolan[j,k], Victoria A. McCredie[l,m,n], Andrew Petrosoniak[o], Christopher Hicks[o], Elliott R. Haut[p,q], Jeffrey J. Perry[b,d,g]*

Predictors of survival in TCA?

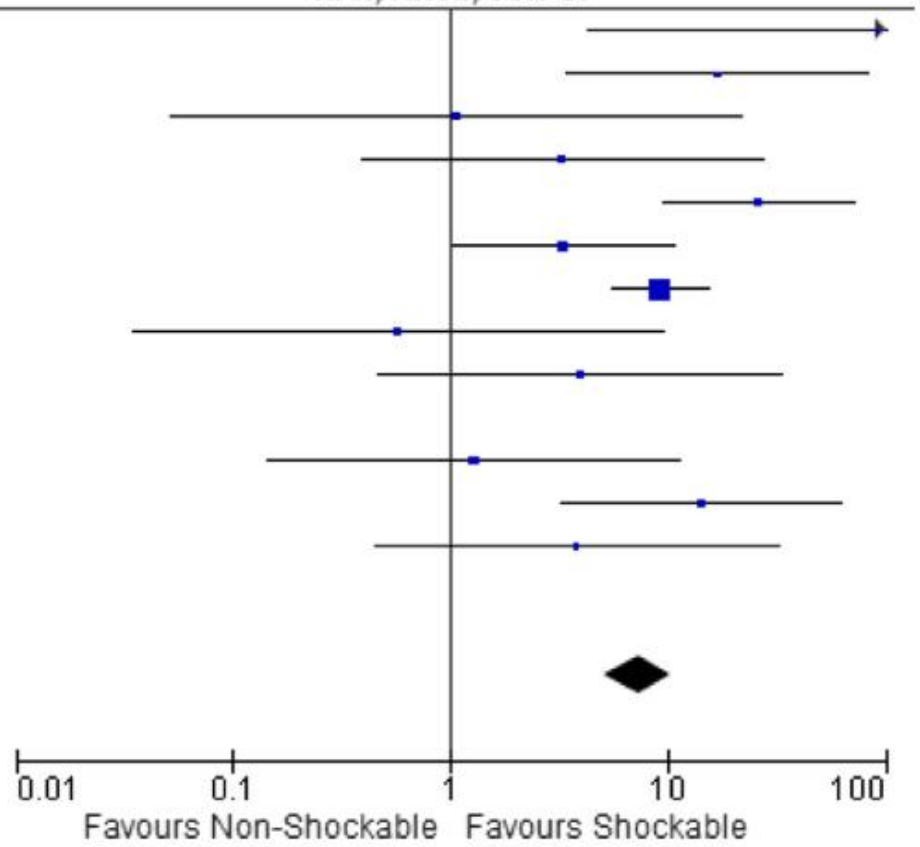
1. Witnessed arrest
2. Wall motion on ECHO
3. CPR
4. Shockable rhythm

Initial Cardiac Rhythm (Shockable vs. Non-Shockable)

Study or Subgroup	Shockable Events	Shockable Total	Non-Shockable Events	Non-Shockable Total	Weight	Odds Ratio M-H, Fixed, 95% CI
Aprahamian 1985	3	9	0	86	0.5%	93.15 [4.33, 2003.76]
Barnard 2019	3	15	4	274	2.3%	16.88 [3.39, 83.98]
Cera 2003	0	13	3	102	5.7%	1.05 [0.05, 21.52]
Chen 2019	1	16	9	447	4.1%	3.24 [0.39, 27.28]
Chiang 2015	9	24	11	490	4.5%	26.13 [9.42, 72.45]
Deasy 2012	4	34	13	336	14.9%	3.31 [1.02, 10.80]
Djarv 2018	29	165	36	1601	39.2%	9.27 [5.51, 15.58]
Esposito 1991	1	71	1	41	8.8%	0.57 [0.03, 9.39]
Irfan 2017	1	12	9	398	3.4%	3.93 [0.46, 33.77]
Israr 2019	0	0	5	257		Not estimable
Konesky 2017	1	11	8	110	9.3%	1.27 [0.14, 11.26]
Leis 2013	4	11	6	155	3.6%	14.19 [3.25, 62.02]
Moriwaki 2011	1	11	12	466	3.6%	3.78 [0.45, 31.97]
Wright 1989	0	5	0	62		Not estimable
Total (95% CI)		**397**		**4825**	**100.0%**	**7.29 [5.09, 10.44]**
Total events	57		117			

Heterogeneity: Chi² = 21.49, df = 11 (P = 0.03); I² = 49%

Test for overall effect: Z = 10.83 (P < 0.00001)



Observational Study

Medicine®

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Outcome analysis of traumatic out-of-hospital cardiac arrest patients according to the mechanism of injury

A nationwide observation study

Jae Guk Kim, MD[a,b], Juncheol Lee, MD[c], Hyun Young Choi, MD, PhD[a], Wonhee Kim, MD, PhD[a], Jihoon Kim, MD, PhD[d,*], Shinje Moon, MD[e], Hyungoo Shin, MD, PhD[f], Chiwon Ahn, MD[g], Youngsuk Cho, MD[h], Dong Geum Shin, MD[i], Yoonje Lee, MD, PhD[a]

Table 2

Multivariate logistic analysis of survival to hospital discharge and good neurological outcome.

Outcomes	Factors	aOR (95% CI)*	*P*-value
Survival to hospital discharge	Male	1.574 (1.235–2.006)	<.001
	Prehospital ROSC	17.926 (11.135–28.859)	<.001
	Initial shockable rhythm	3.421 (1.963–5.962)	<.001
	Mechanism of injury		
	Traffic accident	Reference	
	Fall	1.019 (0.816–1.274)	.866
	Collision	2.440 (1.795–3.317)	<.001
	Stab injury	1.035 (0.548–1.955)	.916
	Gunshot	0.000 (0.000–0.000)	.999
Good neurological outcome at hospital discharge	Male	3.023 (0.848–10.781)	.088
	Prehospital ROSC	37.608 (16.683–84.780)	<.001
	Initial shockable rhythm	8.998 (3.381–23.941)	<.001
	Mechanism of injury†	N/A	N/A

Survival to discharge

- Initial shockable ECG rhythm **13.3%**
- Any organized ECG activity **4.1%**
- Asystole **1%**

Injury 52 (2021) 1117–1122

Contents lists available at ScienceDirect

Injury

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

Outcomes after Prehospital Traumatic Cardiac Arrest in the Netherlands: a Retrospective Cohort Study

Thymen Houwen[a], Zar Popal[b], Marcel A.N. de Bruijn[c], Anna-Marie R. Leemeyer[a], Joost H. Peters[c], Maartje Terra[b], Esther M.M. van Lieshout[a], Michael H.J. Verhofstad[a], Mark G. van Vledder[a,*]

RESEARCH Open Access

Traumatic cardiac arrest – a nationwide Danish study

Signe Amalie Wolthers[1,2*], Theo Walther Jensen[1], Niklas Breindahl[1,2,3], Louise Milling[4,5], Stig Nikolaj Blomberg[1], Lars Bredevang Andersen[1], Søren Mikkelsen[4,5], Christian Torp-Pedersen[6,7,8] and Helle Collatz Christensen[1,2,9]

Wolthers *et al. BMC Emergency Medicine* (2023) 23:69
https://doi.org/10.1186/s12873-023-00839-1

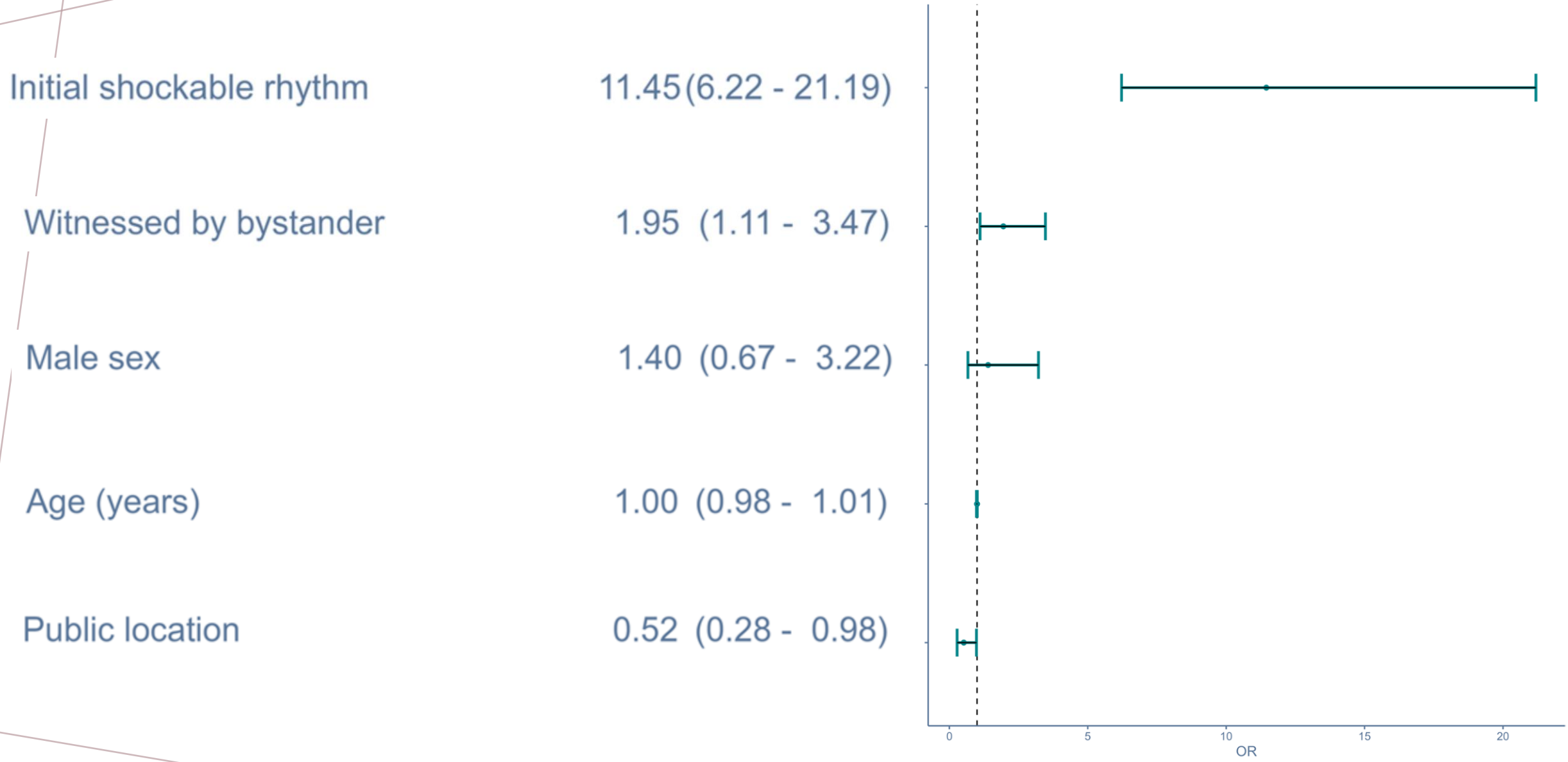


Fig. 2 Multivariable analysis for 30-day Survival in Traumatic Cardiac Arrest in Denmark between 2016 and 2021

The analysis was adjusted for initial shockable rhythm, observation of occurrence, sex, age and location of the arrest. OR: Odds ratio

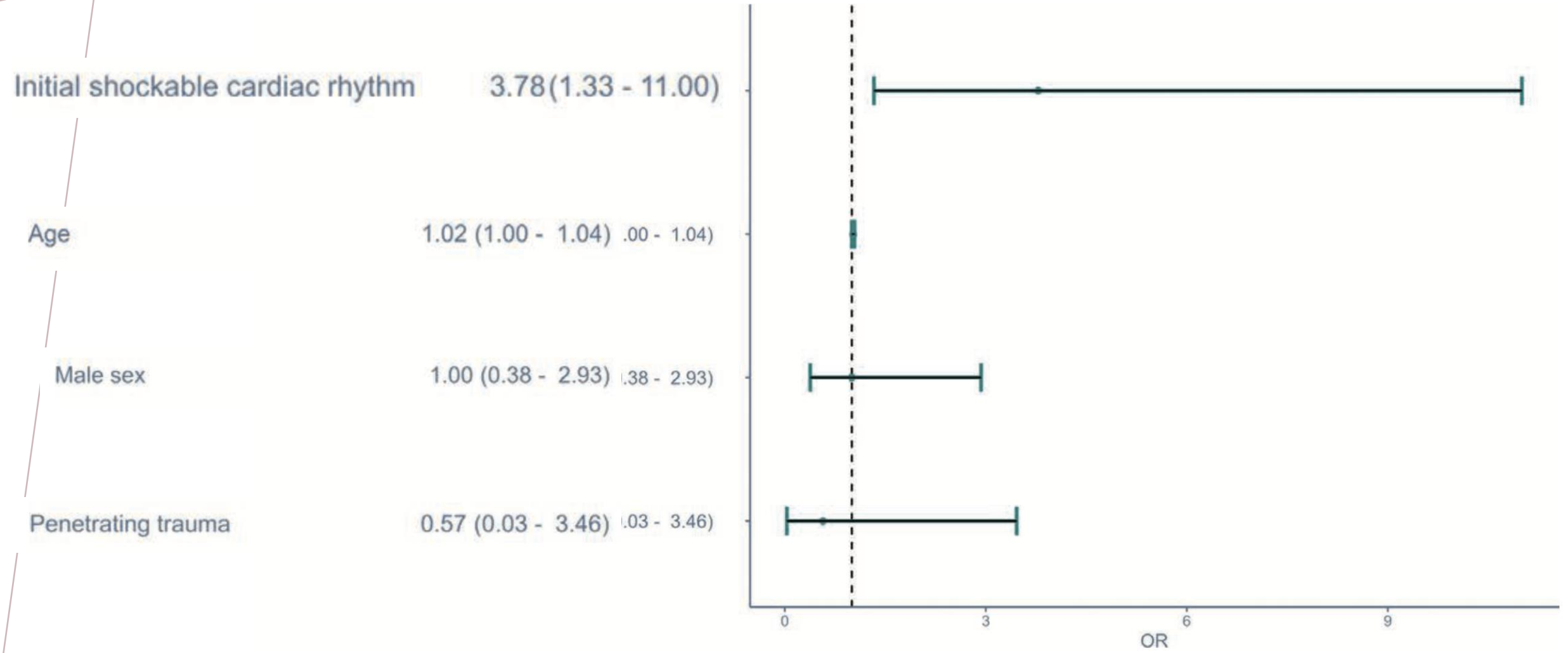
Prehospital interventions and outcomes in traumatic cardiac arrest: a population-based cohort study using the Danish Helicopter Emergency Medical Services data

Signe Amalie Wolthers[a,b], Niklas Breindahl[a,b,c], Theo Walther Jensen[a,d], Mathias Geldermann Holgersen[b,e], Thea Palsgaard Møller[a,f], Stig Nikolaj Fasmer Blomberg[a], Lars Bredevang Andersen[a],Søren Mikkelsen[g], Jacob Steinmetz[h,i,j] and Helle Collatz Christensen[a,b]

European Journal of Emergency Medicine 2024, **31**:324–331

DOI: 10.1097/MEJ.0000000000001108

Fig. 2



Multivariable analysis of return of spontaneous circulation and potential prognostic pre- and intra-arrest factors in patients with traumatic cardiac arrest. The analysis was adjusted for age, sex, initial shockable rhythm, and penetrating trauma. OR, odds ratio.

PREHOSPITAL EMERGENCY CARE
2023, VOL. 27, NO. 8, 978–986
https://doi.org/10.1080/10903127.2022.2113941

Taylor & Francis
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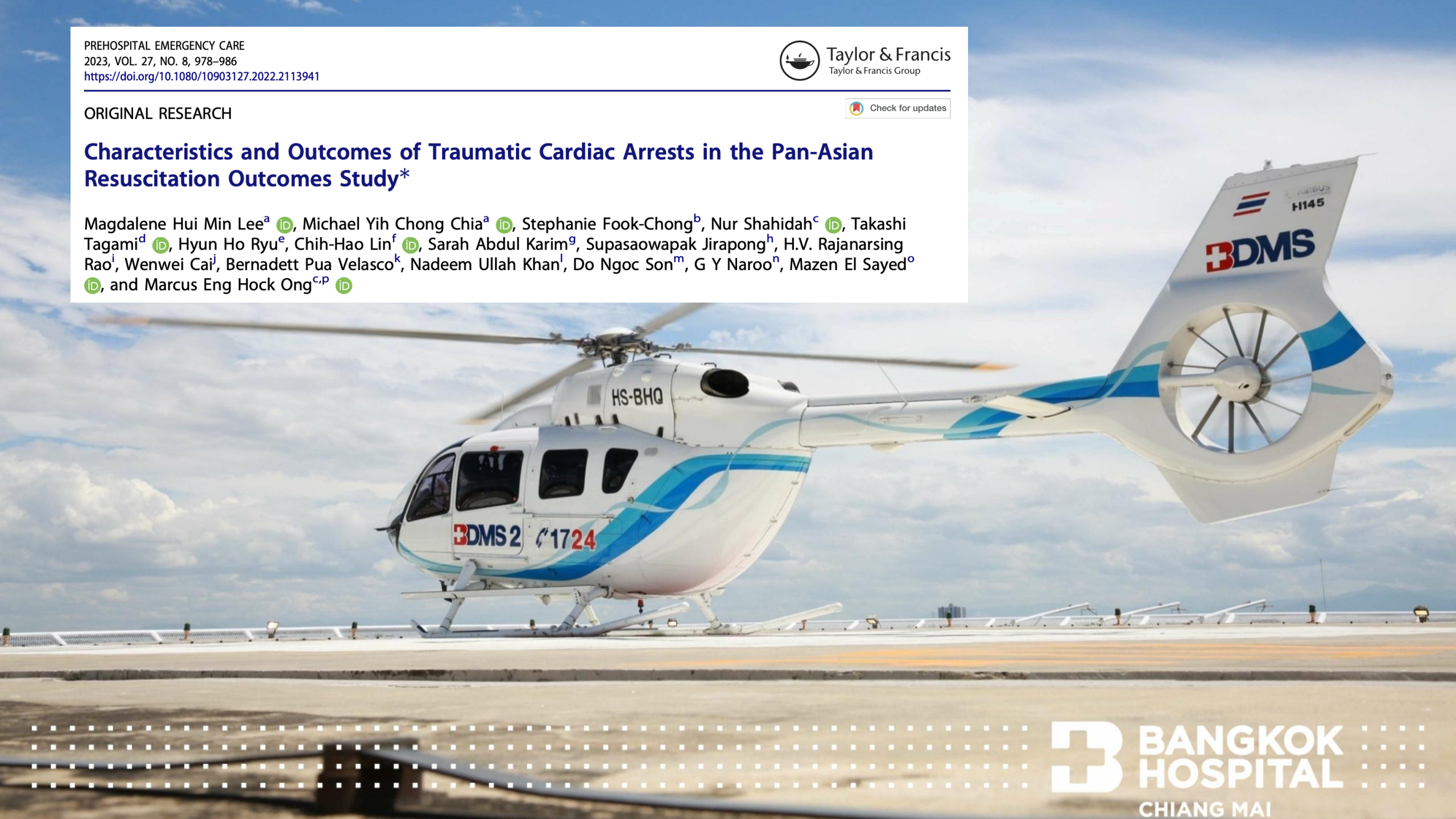
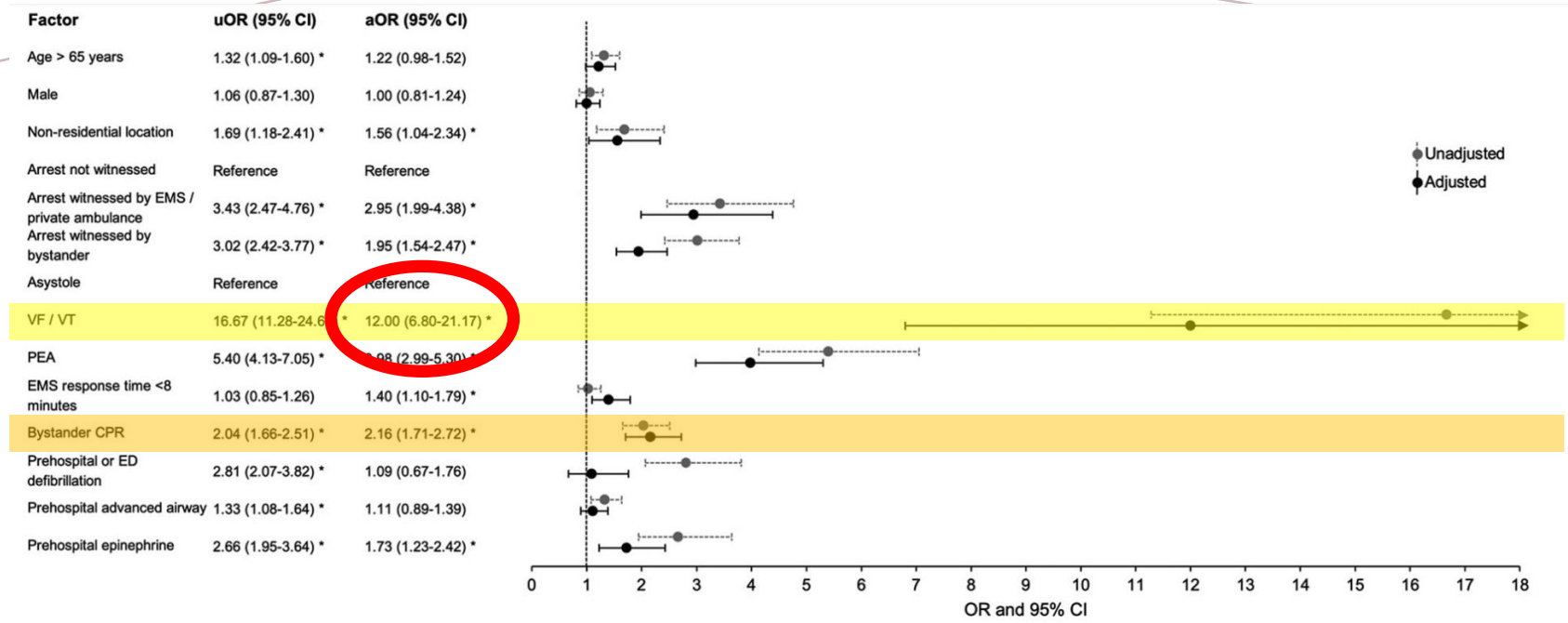
ORIGINAL RESEARCH

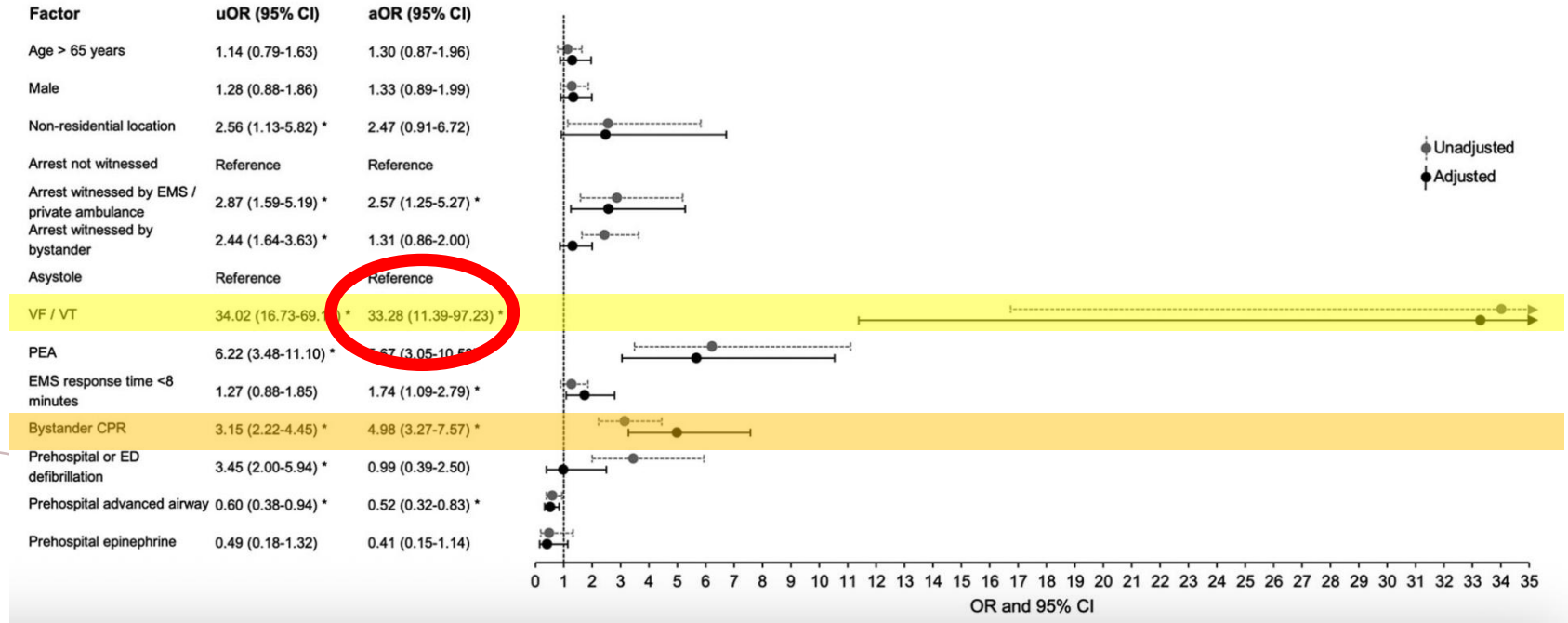
Characteristics and Outcomes of Traumatic Cardiac Arrests in the Pan-Asian Resuscitation Outcomes Study*

Magdalene Hui Min Lee[a], Michael Yih Chong Chia[a], Stephanie Fook-Chong[b], Nur Shahidah[c], Takashi Tagami[d], Hyun Ho Ryu[e], Chih-Hao Lin[f], Sarah Abdul Karim[g], Supasaowapak Jirapong[h], H.V. Rajanarsing Rao[i], Wenwei Cai[j], Bernadett Pua Velasco[k], Nadeem Ullah Khan[l], Do Ngoc Son[m], G Y Naroo[n], Mazen El Sayed[o], and Marcus Eng Hock Ong[c,p]





Association of factors with survival to discharge



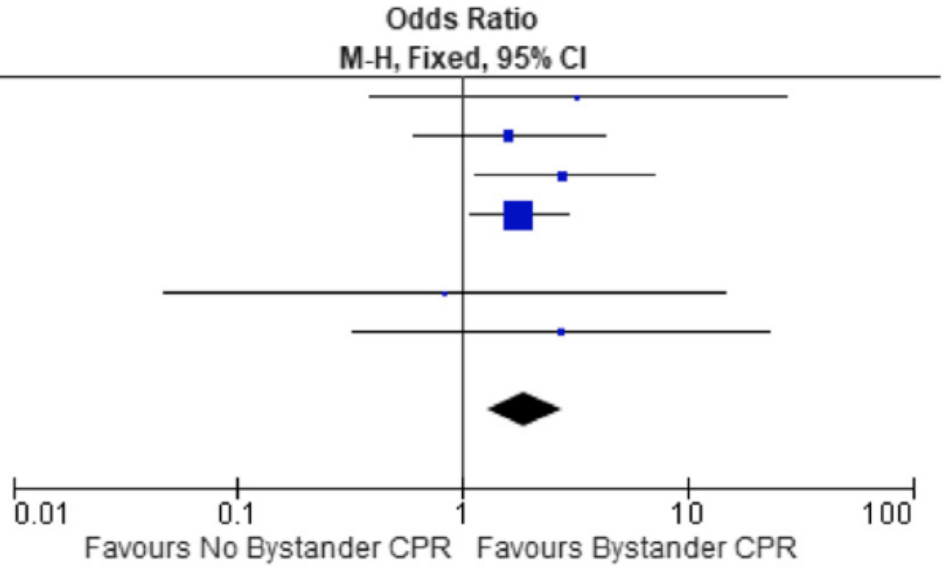
Association of factors with neurologically favourable survival (CPC 1-2)

Bystander CPR (Yes vs. No)

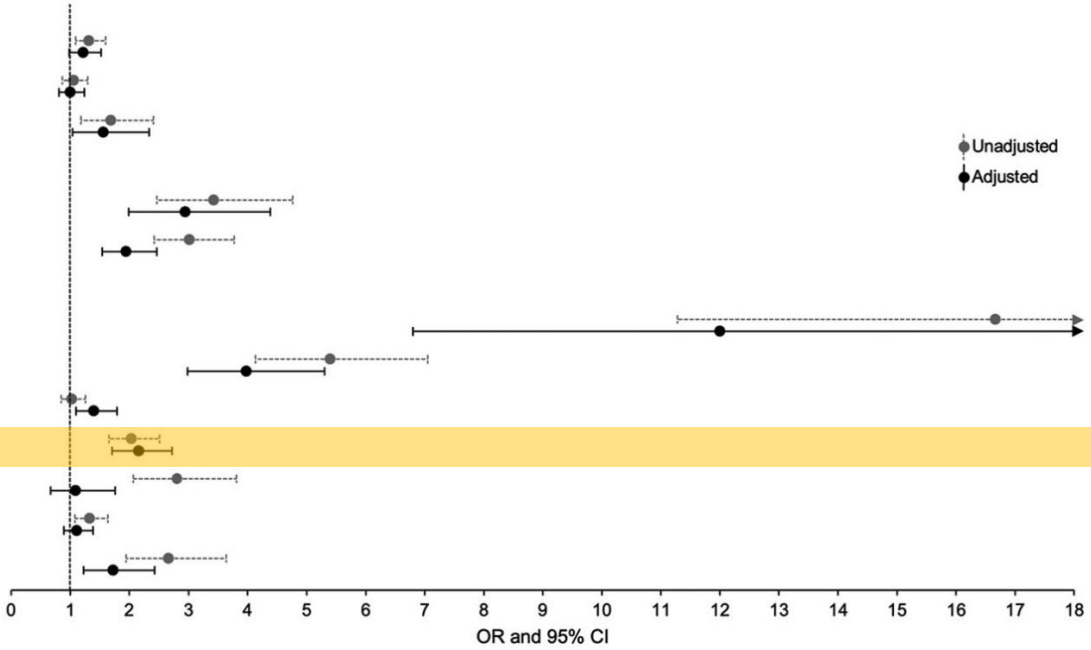
Study or Subgroup	Bystander CPR Events	Bystander CPR Total	No Bystander CPR Events	No Bystander CPR Total	Weight	Odds Ratio M-H, Fixed, 95% CI
Chen 2019	1	16	9	447	1.6%	3.24 [0.39, 27.28]
Chiang 2015	6	110	14	404	16.0%	1.61 [0.60, 4.28]
Deasy 2012	6	192	22	1933	10.9%	2.80 [1.12, 7.00]
Djarv 2018	37	738	28	973	64.7%	1.78 [1.08, 2.94]
Huber-Wagner 2007	130	757	0	0		Not estimable
Irfan 2017	0	21	10	385	3.1%	0.83 [0.05, 14.67]
ter Avest 2019	6	181	1	81	3.8%	[0.32, 23.16]
Total (95% CI)		**2015**		**4223**	**100.0%**	**1.89 [1. 9, 2.79]**
Total events	186		84			

Heterogeneity: Chi² = 1.55, df = 5 (P = 0.91); I² = 0%

Test for overall effect: Z = 3.24 (P = 0.001)

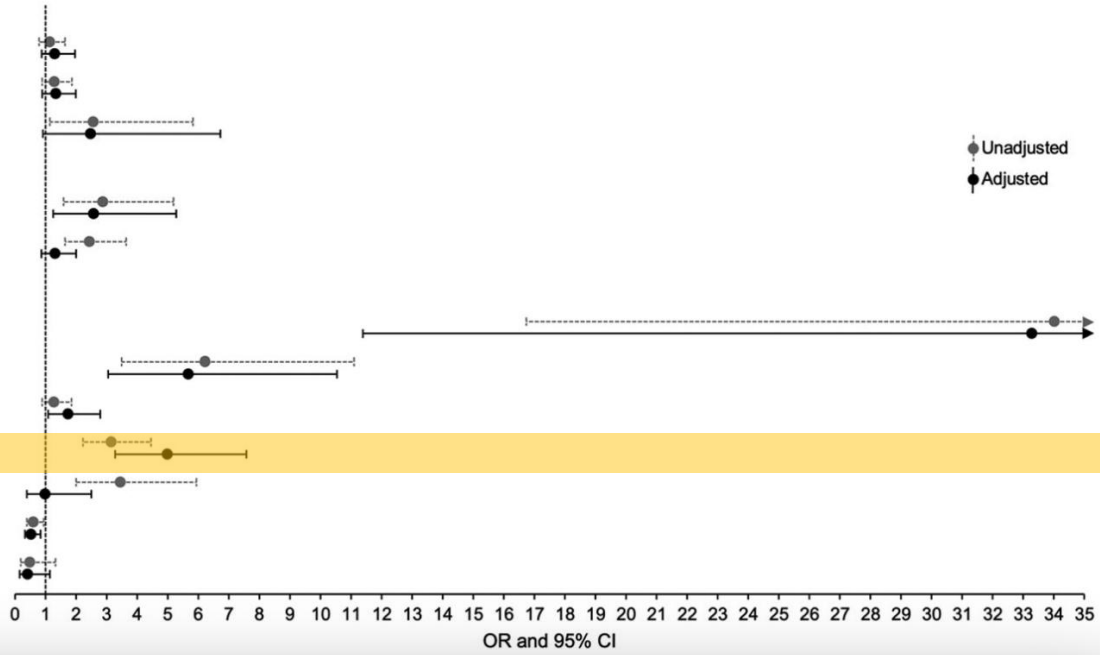


Factor	uOR (95% CI)	aOR (95% CI)
Age > 65 years	1.32 (1.09-1.60) *	1.22 (0.98-1.52)
Male	1.06 (0.87-1.30)	1.00 (0.81-1.24)
Non-residential location	1.69 (1.18-2.41) *	1.56 (1.04-2.34) *
Arrest not witnessed	Reference	Reference
Arrest witnessed by EMS / private ambulance	3.43 (2.47-4.76) *	2.95 (1.99-4.38) *
Arrest witnessed by bystander	3.02 (2.42-3.77) *	1.95 (1.54-2.47) *
Asystole	Reference	Reference
VF / VT	16.67 (11.28-24.63) *	12.00 (6.80-21.17) *
PEA	5.40 (4.13-7.05) *	3.98 (2.99-5.30) *
EMS response time <8 minutes	1.03 (0.85-1.26)	1.40 (1.10-1.79)
Bystander CPR	2.04 (1.66-2.51) *	2.16 (1.71-2.72) *
Prehospital or ED defibrillation	2.81 (2.07-3.82) *	1.09 (0.67-1.76)
Prehospital advanced airway	1.33 (1.08-1.64) *	1.11 (0.89-1.39)
Prehospital epinephrine	2.66 (1.95-3.64) *	1.73 (1.23-2.42) *



Association of factors with survival to discharge

Factor	uOR (95% CI)	aOR (95% CI)
Age > 65 years	1.14 (0.79-1.63)	1.30 (0.87-1.96)
Male	1.28 (0.88-1.86)	1.33 (0.89-1.99)
Non-residential location	2.56 (1.13-5.82) *	2.47 (0.91-6.72)
Arrest not witnessed	Reference	Reference
Arrest witnessed by EMS / private ambulance	2.87 (1.59-5.19) *	2.57 (1.25-5.27) *
Arrest witnessed by bystander	2.44 (1.64-3.63) *	1.31 (0.86-2.00)
Asystole	Reference	Reference
VF / VT	34.02 (16.73-69.17) *	33.28 (11.39-97.23) *
PEA	6.22 (3.48-11.10) *	5.67 (3.05-10.53) *
EMS response time <8 minutes	1.27 (0.88-1.85)	1.74 (1.09-2.79)
Bystander CPR	3.15 (2.22-4.45) *	4.98 (3.27-7.57) *
Prehospital or ED defibrillation	3.45 (2.00-5.94) *	0.99 (0.39-2.50)
Prehospital advanced airway	0.60 (0.38-0.94) *	0.52 (0.32-0.83) *
Prehospital epinephrine	0.49 (0.18-1.32)	0.41 (0.15-1.14)



Association of factors with neurologically favourable survival (CPC 1-2)

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THE JOURNAL OF TRAUMA
Vol. 29, No. 10

Printed in U.S.A.

Hemodynamic Effects of External Cardiac Massage in Trauma Shock

GREGORY K. LUNA, M.D., M.P.H., E. G. PAVLIN, M.D., TOM KIRKMAN, B.S., MICHAEL K. COPASS, M.D., AND CHARLES L. RICE, M.D.

Use of CPR in hemorrhagic shock, a dog model

DOI: 10.1097/TA.0000000000001001

J Trauma Acute Care Surg
Volume 81, Number 1

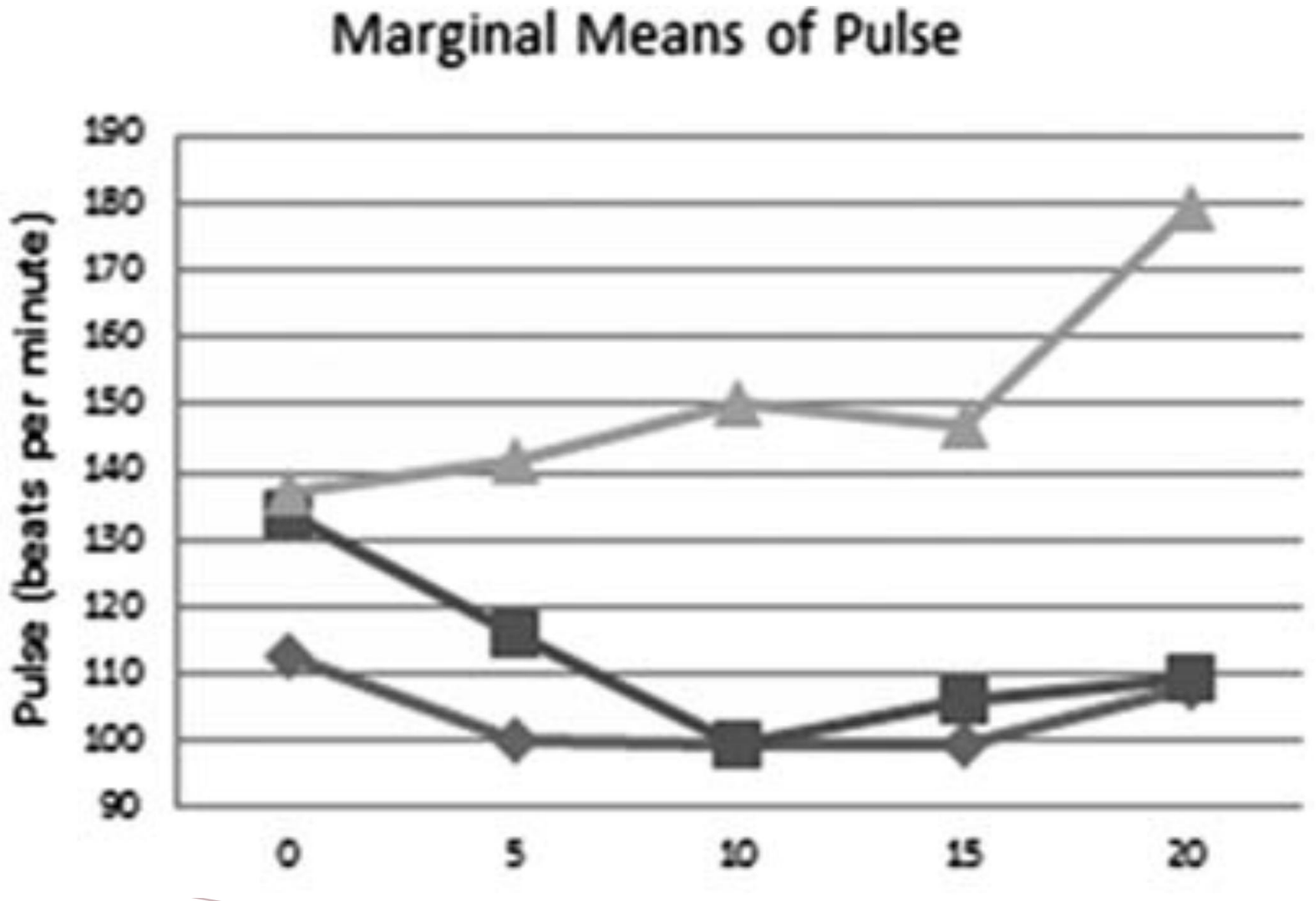
David R. Jeffcoach, MD, Juan J. Gallegos, MD, Sophy A. Jesty, DVM, Patricia N. Coan, DVM, PhD, Jason Chen, MD, Robert Eric Heidel, PhD, *and* **Brian J. Daley, MD**, *Knoxville, Tennessee*

EXPERIMENTAL PAPER · Volume 140, P37-42, July 2019 ·

Closed chest compressions reduce survival in an animal model of haemorrhage-induced traumatic cardiac arrest

Sarah Watts [a] · Jason E. Smith [b,c] · Robert Gwyther [a] · Emrys Kirkman [a]

Affiliations & Notes · Article Info


Marginal Means of Pulse
Pulse (beats per minute)
190
180
170
160
150
140
130
120
110
100
90
0
5
10
15
20

Injury 52 (2021) 1117–1122

Contents lists available at ScienceDirect

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

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First ECG rhythm	
Asystole	402 (50.3%)
PEA	367 (45.9%)
Shockable (VF/VT)	30 (3.8%)
Undocumented	116

SPECIAL REPORT

Pulseless Electric Activity

Definition, Causes, Mechanisms, Management, and Research Priorities for the Next Decade: Report From a National Heart, Lung, and Blood Institute Workshop

Circulation

Volume 128, Issue 23, 1 December 2013; Pages 2532-2541

https://doi.org/10.1161/CIRCULATIONAHA.113.004490

American Heart Association®

Definition of PEA

At present, there is no single unifying definition for PEA. The common denominator is the presence of spontaneous organized cardiac electric activity in the absence of blood flow sufficient to maintain consciousness and absence of a rapid spontaneous return of adequate organ perfusion and consciousness (see the Table).

Table. Tachyarrhythmic and Nontachyarrhythmic Cardiac Arrest

Primary Arrhythmias	Electrical Mechanisms	Mechanical Mechanisms
Tachyarrhythmic cardiac arrest		
VF	Absence of organized ventricular depolarization	Absence of LVWM
Pulseless VT	Organized ventricular pattern; rapid rate	
Secondary arrhythmias		
Sinus tachycardia; other	Sinus or other SV rhythm; narrow QRS	Obstruction to cardiac blood flow; hypovolemia
Nontachyarrhythmic cardiac arrest		
PEA, primary (initial rhythm)		
With residual LV contraction	Organized QRS complexes, usually wide	LVWM insufficient for organ perfusion
Without LV contraction	Organized QRS complexes, usually wide	Absence of LVWM
PEA, secondary		
Postshock	Regular or irregular QRS complexes, usually wide	Absent LVWM or LVWM insufficient for organ perfusion
Primary noncardiac	Regular or irregular QRS complexes, usually wide	Usually LVWM insufficient for organ perfusion; LVWM may be absent
Agonal PEA	Slow, usually irregular, wide QRS	Absence of LVWM
Ventricular asystole	Absent ventricular electric activity; exclude fine VF	Absence of LVWM

LV indicates left ventricular; LVWM, left ventricular wall motion; PEA, pulseless electric activity; SV, supraventricular; VF, ventricular fibrillation; and VT, ventricular tachycardia.

Sinus Tachycardia Vs True PEA

Author & year	n	Country	% Sinus/sinus tachycardia	% Penetrating
Esposito 1991	112	USA	15	21
Battistella 1999	604	USA	42	50
Cera 2003	161	USA	24	35
Willis 2006	89	Australia	25	20
Konesky 2017	197	USA	2	44
Serpa 2023	54	USA	26	41
Perkins 2025	601	UK	23	88
Pooled	**1,818**		**27%**	**57%**

WHAT WE (NOW) KNOW

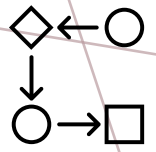
The current algorithm has not improved mortality

Shockable rhythm is the single best indicator of potential survival

Most TCA patients have a non-perfusing rhythm and need CPR (unless instrumenting the chest for tension/tamponade)

A new approach is required

BROOTT TCA Drill



Bleeding
Control massive external haemorrhage

Rhythm check
CPR whilst monitor attached

Output?
- Shockable rhythm -> shock
- Narrow complex tachycardia -> No CPR, seek reversible causes
- Otherwise -> CPR whilst seeking reversible causes

Oxygenate
100% O_2 via least invasive means

Exclude Tension / Tamponade
- Chest decompression
- Thoracotomy

Transfuse
Balanced blood products preferred

TELL ME WHY I'M WRONG