



CONGRESSO NAZIONALE IRC 2 22

TRAUMA: NUOVE EVIDENZE E PERCORSI

AUDITORIUM DELLA TECNICA • ROMA • 14-15 OTTOBRE



Italian
Resuscitation
Council

La cassetta degli attrezzi nell'arresto traumatico

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Overview

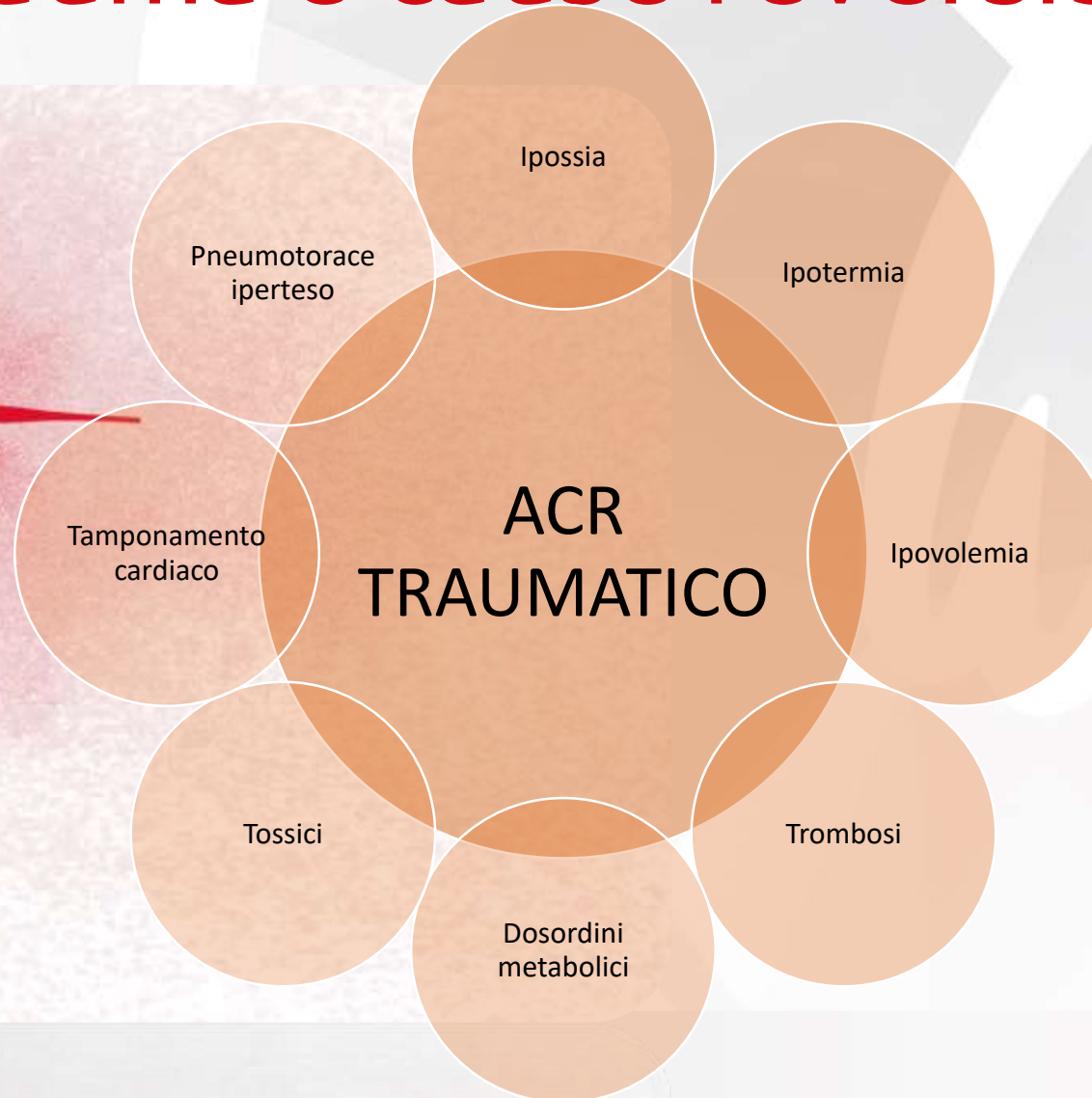
Background

Algoritmo proposto

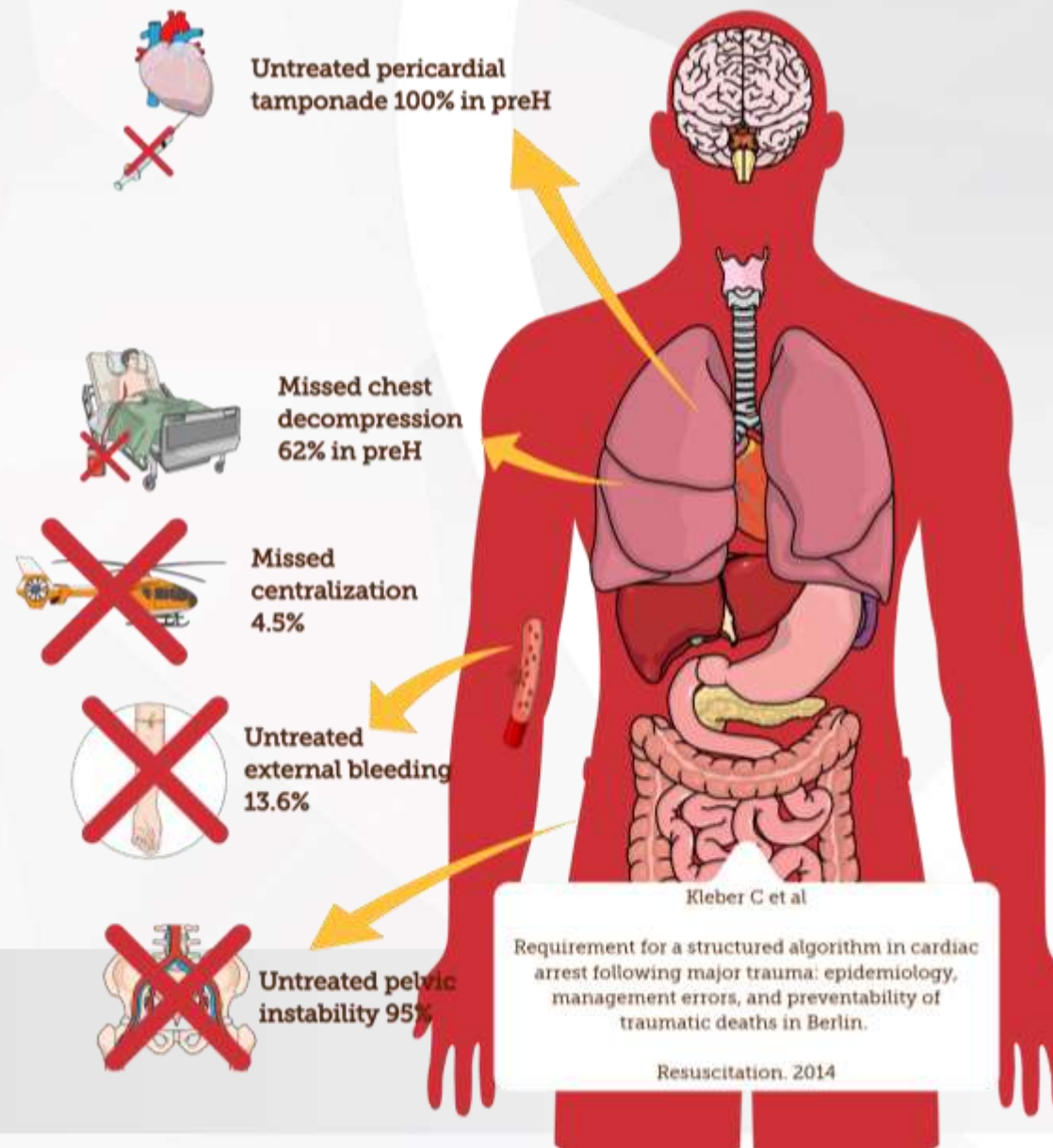
Singoli interventi

Contesto e sistema

Trauma e cause reversibili



Management errors



US after 2018

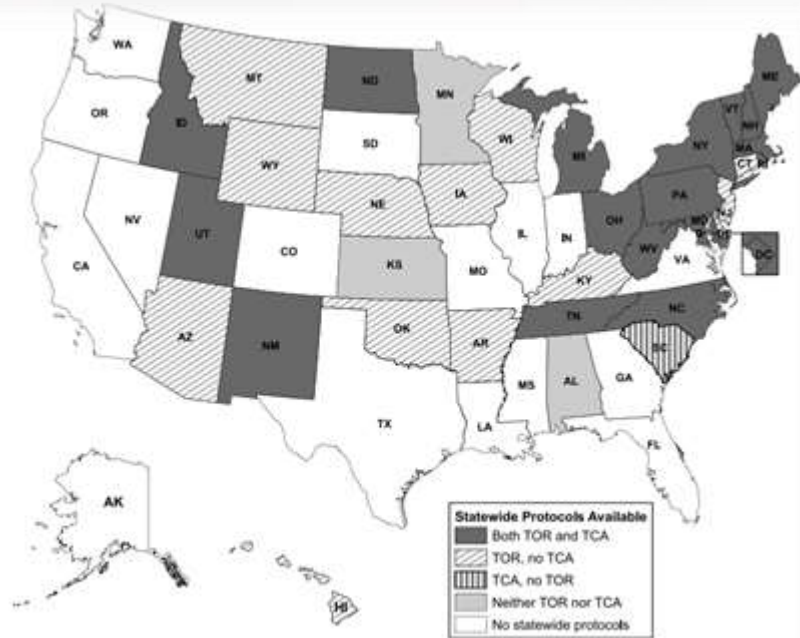


Fig. 1 - Variation in prehospital traumatic cardiac arrest and termination of resuscitation protocols across the U.S.

Table 3 - Procedures performed during EMS activations for traumatic cardiac arrest.

Procedure	All Incidents	Blunt Trauma	Penetrating Trauma	P-value ^A
Airway management				
Basic airway management (OPA/NPA, BVM)	4,007 (41.9%)	2,786 (42.7%)	713 (41.3%)	0.32
Extraglottic airway	1,109 (11.6%)	804 (12.3%)	200 (11.6%)	0.44
Endotracheal intubation	3,057 (32.0%)	2,091 (32.0%)	563 (32.6%)	0.66
Failed advanced airway attempt	981 (10.3%)	733 (11.2%)	145 (8.4%)	<0.001
Needle decompression	748 (7.8%)	438 (6.7%)	261 (15.1%)	<0.001
Vascular access (IV/IO)	6,368 (66.6%)	4,426 (67.8%)	1,140 (66.1%)	0.18
Crystalloid fluid administration	2,753 (28.8%)	1,931 (29.6%)	505 (29.3%)	0.82
Tranexamic acid administration	41 (0.4%)	18 (0.3%)	21 (1.2%)	<0.001
Epinephrine administration	5,747 (60.1%)	4,016 (61.5%)	909 (52.7%)	<0.001
Bleeding control procedures				
Direct pressure or hemostatic agent	405 (4.2%)	89 (1.4%)	290 (16.8%)	<0.001
Tourniquet	80 (0.8%)	47 (0.7%)	24 (1.4%)	0.01
Pelvic binder	12 (0.1%)	9 (0.1%)	0 (0%)	0.26
Splinting	33 (0.3%)	29 (0.4%)	0 (0%)	0.01
Spinal immobilization	505 (5.3%)	405 (6.2%)	41 (2.4%)	<0.001
CPR				
None	1,234 (12.9%)	804 (12.3%)	256 (14.8%)	<0.001
Manual CPR only	6,643 (69.5%)	4,516 (69.2%)	1,232 (71.4%)	0.08
Mechanical CPR	1,688 (17.6%)	1,206 (18.5%)	237 (13.7%)	<0.001
Defibrillation	2,163 (22.6%)	1,661 (25.5%)	172 (10.0%)	<0.001

Abbreviations: BVM, bag-valve mask; CPR, cardiopulmonary resuscitation; IO, intraosseous; IV, intravenous; NPA, nasopharyngeal airway; OPA, oropharyngeal airway.

^A P-values correspond to χ^2 tests.

Survival after T-OHCA overview

Table 1 (continued)

Source	All patients with traumatic CA and CPR started GRR group of high-quality data	Admitted to hospital with ROSC GRR group of high-quality data	Admitted to hospital with ROSC TR-DGU
Time on scene – missing	n = 56	n = 19	n = 563 ^a
Time from accident to hospital admission in min: mean (SD)	60.1 (21.8)	63.6 (22.9)	69.7 (29.1)
Time from accident to hospital – missing	n = 54	n = 20	n = 301
Injury Severity Score: mean (SD)			35.6 (20.2)
Injury Severity Score: median [quartiles]			33 [21–50]
Again CA/CPR in ER			28.2% ^a
Time in the ER in min: mean (SD)			68.7 (56.5) ^a
Admitted to ICU			81.6%
Died in the ER			16.4%
Declared dead on scene	643 (67.8%)	0	
Died in hospital	259 (27.3%)	138 (75.4%)	71.1%
Died overall	902 (95.0%)		
Died – missing data (n)	100	57	0
CPC 1 or 2 at discharge (survivor only)	25 of 32 (78.1%)	25 of 32 (78.1%)	383 of 696 (55.0%) (adapted GOS 4+5)
CPC – missing data	15	13	16

CA Cardiac arrest, CPC Cerebral performance category, CPR Cardiopulmonary resuscitation, EMS Emergency medical service, ER Emergency room, GOS Glasgow outcome scale, GRR German Resuscitation Registry, PEA Pulseless electrical activity, SD Standard deviation, ICU Intensive care unit, ROSC Return of spontaneous circulation, VF Ventricular fibrillation

^a available only for TR-DGU patients with standard documentation (56%)

^b includes doctors' offices and smaller rehabilitation clinics and affiliated hospitals that do not provide their own resuscitation team but alert the EMS in such a case

Seewald, S., Wnent, J., Gräsner, JT. *et al.* Survival after traumatic cardiac arrest is possible—a comparison of German patient-registries. *BMC Emerg Med* **22**, 158 (2022).
<https://doi.org/10.1186/s12873-022-00714-5>



Survival after T-OHCA overview

Prehospital traumatic cardiac arrest: a systematic review and meta-analysis

Niek Johannes Vianen¹ · Esther Maria Maartje Van Lieshout¹ · Iscander Michael Maissan² · Wichor Matthijs Bramer³ · Dennis Den Hartog¹ · Michael Herman Jacob Verhofstad¹ · Mark Gerrit Van Vledder¹

Methods This review was conducted in accordance with the PRISMA and CHARMS guidelines. Databases were searched for primary studies published about prehospital TCA patients (1995–2020). Studies were divided into various EMS-system categories. Data were analyzed using MedCalc, Review Manager, Microsoft Excel, and Shinyapps Meta Power Calculator software.

Results Thirty-six studies involving 51.722 patients were included. Overall mortality for TCA was 96.2% and a favorable neurological outcome was seen in 43.5% of the survivors. Mortality rates were 97.2% in studies including prehospital deaths and 92.3% in studies excluding prehospital deaths. Favorable neurological outcome rates were 35.8% in studies including prehospital deaths and 49.5% in studies excluding prehospital deaths. Mortality rates were 97.6% if no physician was available at the prehospital scene and 93.9% if a physician was available. Favorable neurological outcome rates were 57.0% if a physician was available on scene and 38.0% if no physician was available. Only non-shockable rhythm was associated with a higher mortality (RR 1.12, $p=0.06$).

Conclusion Approximately 1 in 20 patients with prehospital TCA will survive; about 40% of survivors have favorable neurological outcome.



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While a part of this effect should be attributed to effective field-triage (with physicians only arriving on-scene when ROSC has already been obtained and physicians dispatch being cancelled in the most severe cases), we do strongly believe that certain patients do benefit from these aggressive resuscitative measures on-scene.

The big question that has not been answered yet, is how to identify those patients who do benefit from on-scene advanced life support, and conversely, those patients who should be transported to a nearby trauma center without any delay. With mortality rates consistently ranging above 90% and a significant proportion of patients having an unfavorable neurologic outcome, everyone will agree that neurological intact survival after TCA is still exceptional. It would therefore be helpful if resource intensive prehospital (and in-hospital) resuscitation attempts could be preserved for those with realistic odds of survival. The most recent ERC

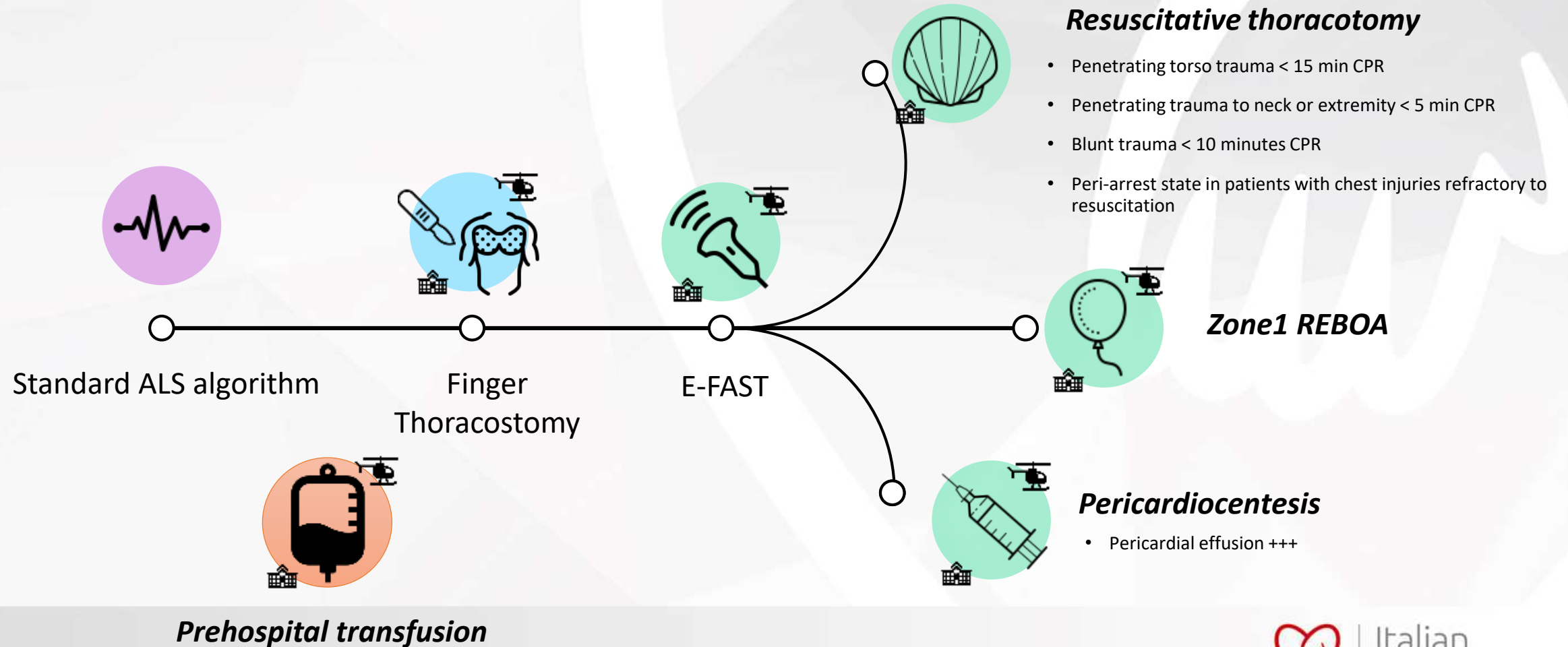
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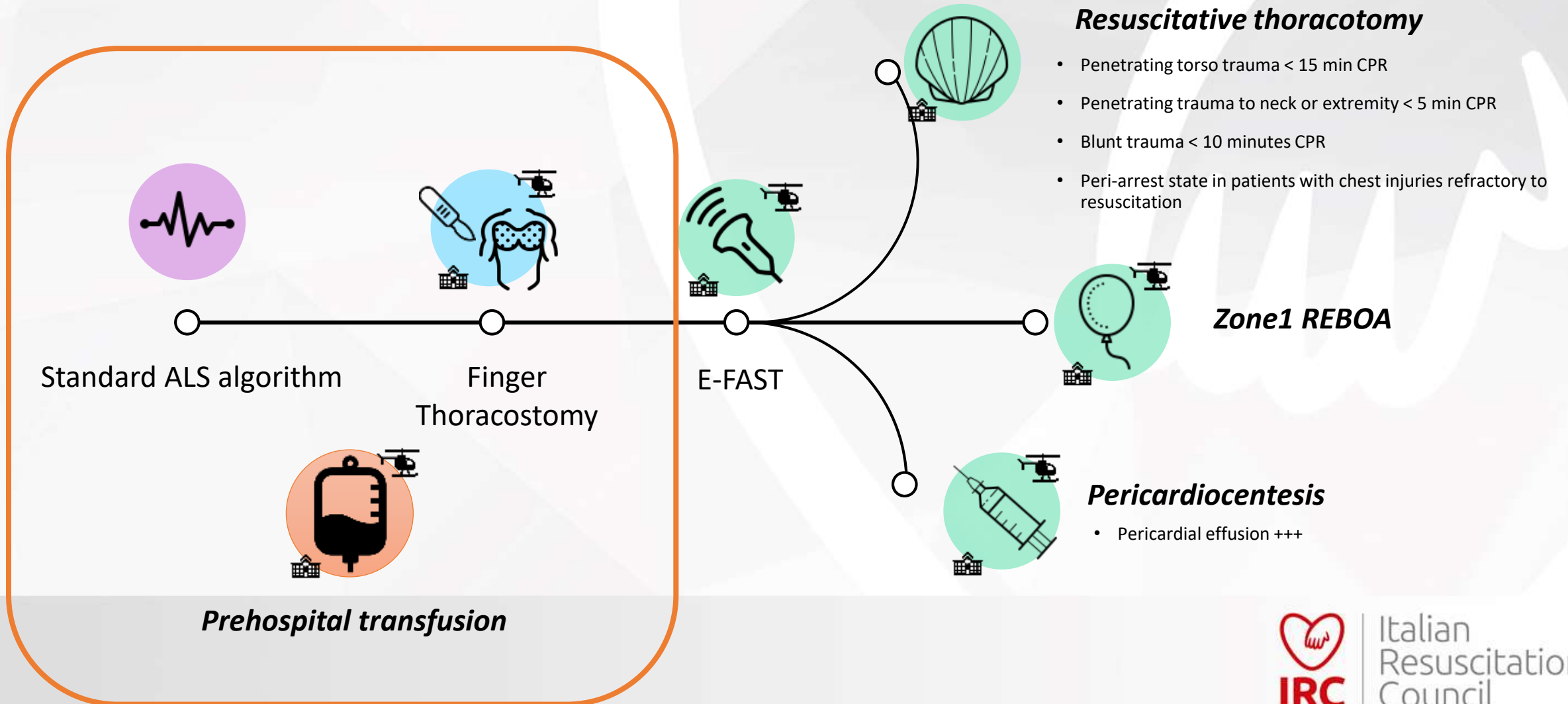
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Algoritmo proposto



Algoritmo proposto

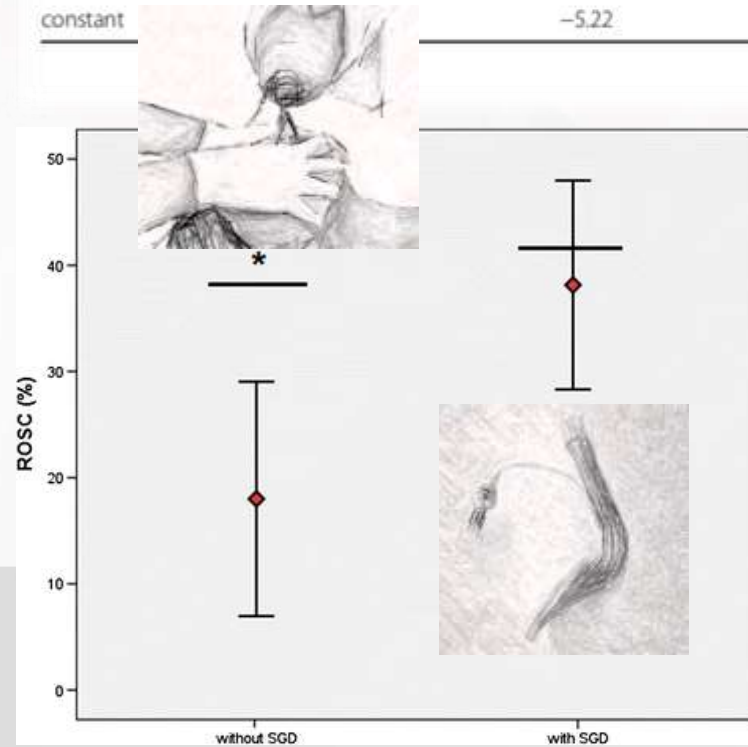


ALS – airway management - A

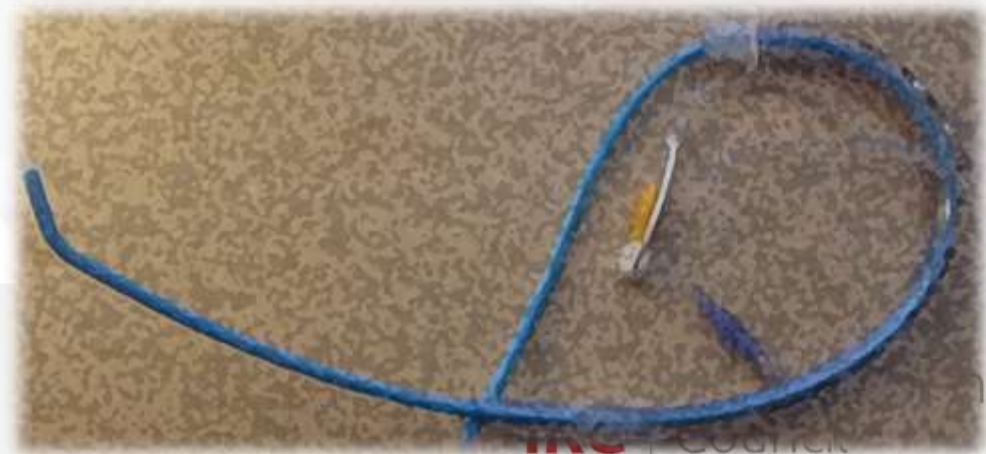


Table 1 Predictors of impossible intubation. (forwards stepwise binary logistic regression analysis) Variables not shown in equation:
Resident physician in internal medicine

	Regression-coefficient	SE	P-value	OR (95 % CI)
Gender male	0.82	0.24	$p = 0.001$	2.28 (1.43–3.63)
Age < 80 years	0.78	0.28	$p = 0.005$	2.18 (1.26–3.76)
presumed etiology			$p = 0.034$	
presumed etiology – trauma	0.80	0.40	$p = 0.046$	2.22 (1.01–4.85)
presumed etiology – hypoxia	0.49	0.27	$p = 0.067$	1.63 (0.97–2.74)
board certified physician in Anesthesia	–0.43	0.20	$p = 0.028$	0.65 (0.44–0.96)
constant	–5.22	0.32	$p < 0.001$	



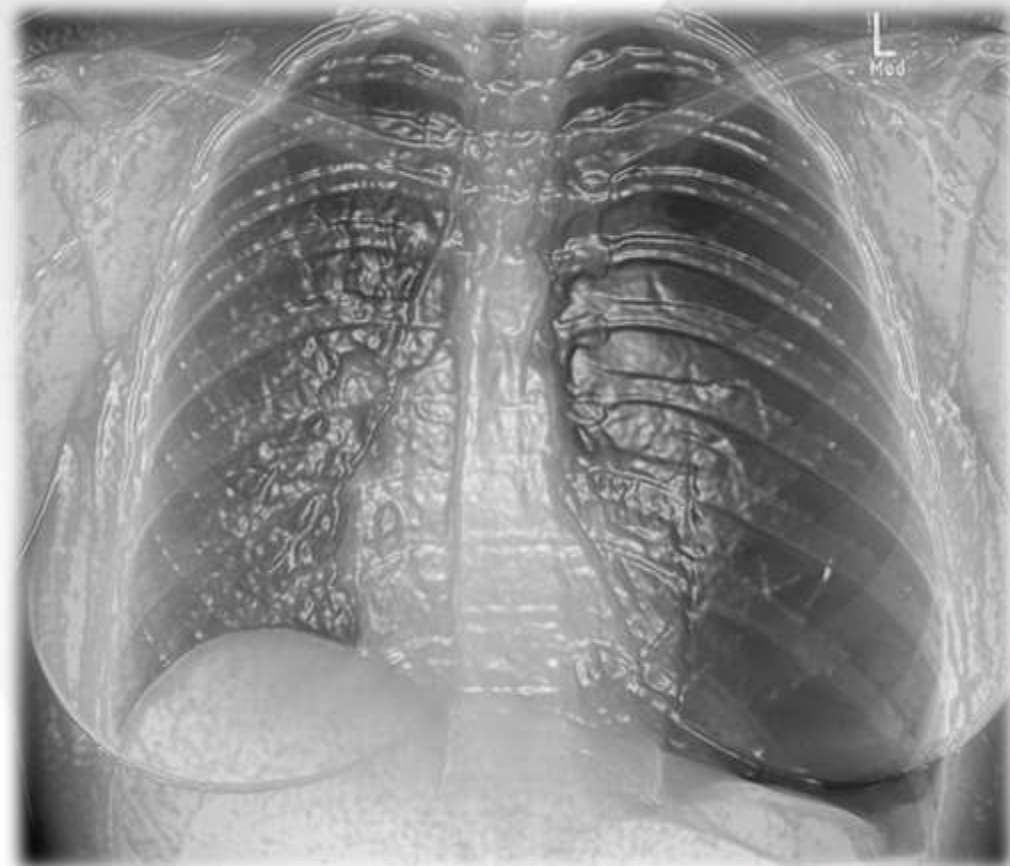
Wnent, J., Franz, R., Seewald, S. *et al.* Difficult intubation and outcome after out-of-hospital cardiac arrest: a registry-based analysis. *Scand J Trauma Resusc Emerg Med* **23**, 43 (2015).
<https://doi.org/10.1186/s13049-015-0124-0>



Pneumotorace iperteso - B



- 10 - 33% dei casi di ACR traumatico
- Fino al 62% dei casi non trattato in preH
- Toracostomia bilaterale
- Iniziare dal lato più lesionato
- Attenzione alla possibile risalita del diaframma



Emorragia - C



- Emorragia esterna non trattata 13.6%
- Instabilità pelvica non trattata > 95%
- Acido tranexamico
- Polveri emostatiche





Emorragia - C



Prehospital blood products RCTs

2018 – PAMPer – Plasma scongelato +/- RBC -> mortalità minore nel gruppo trattato -> maggior beneficio in pazienti ricevanti Plasma + RBC

2018 – COMBAT – Plasma scongelato -> stessa mortalità

2022 – RePHILL – RBC + Plasma liofilizzato -> stessa mortalità

2022 – PREHO-PLYO – plasma liofilizzato -> stessa mortalità

Non disponibili studi specifici su trasfusioni in ACR su umani





Emorragia ACR - C



TCA phase

All animals had a further controlled haemorrhage to achieve a MAP of 20 mmHg. Arterial blood and pulse pressures spontaneously deteriorated over the next 5 min, when the decision to initiate resuscitation was given either by a researcher blinded to the randomised protocol or at 5 min after the attainment of the target MAP.

Resuscitation phase

Animals underwent 3 cycles of resuscitation according to randomised (Excel) group assignment. Group 1 CCC; Group 2 WB (whole blood); Group 3 (0.9% Saline); Group 4 (WB + CCC); and Group 5 (0.9% Saline + CCC).

Fluid was administered at 10 ml/kg (200 ml/min) and closed chest compressions were performed using the LUCAS™ II Chest Compression System.

Calcium chloride was administered intravenously during resuscitation to maintain arterial ionised calcium at ≥ 1 mM (in line with current UK major trauma centre practice and to reduce confounding factors impacting on mortality).

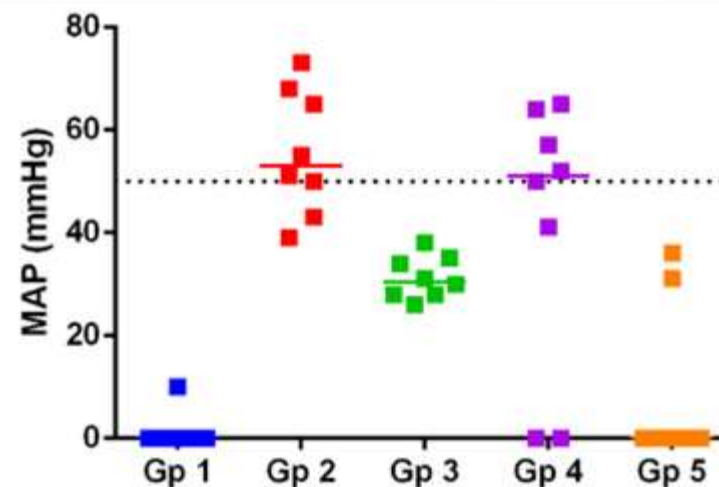
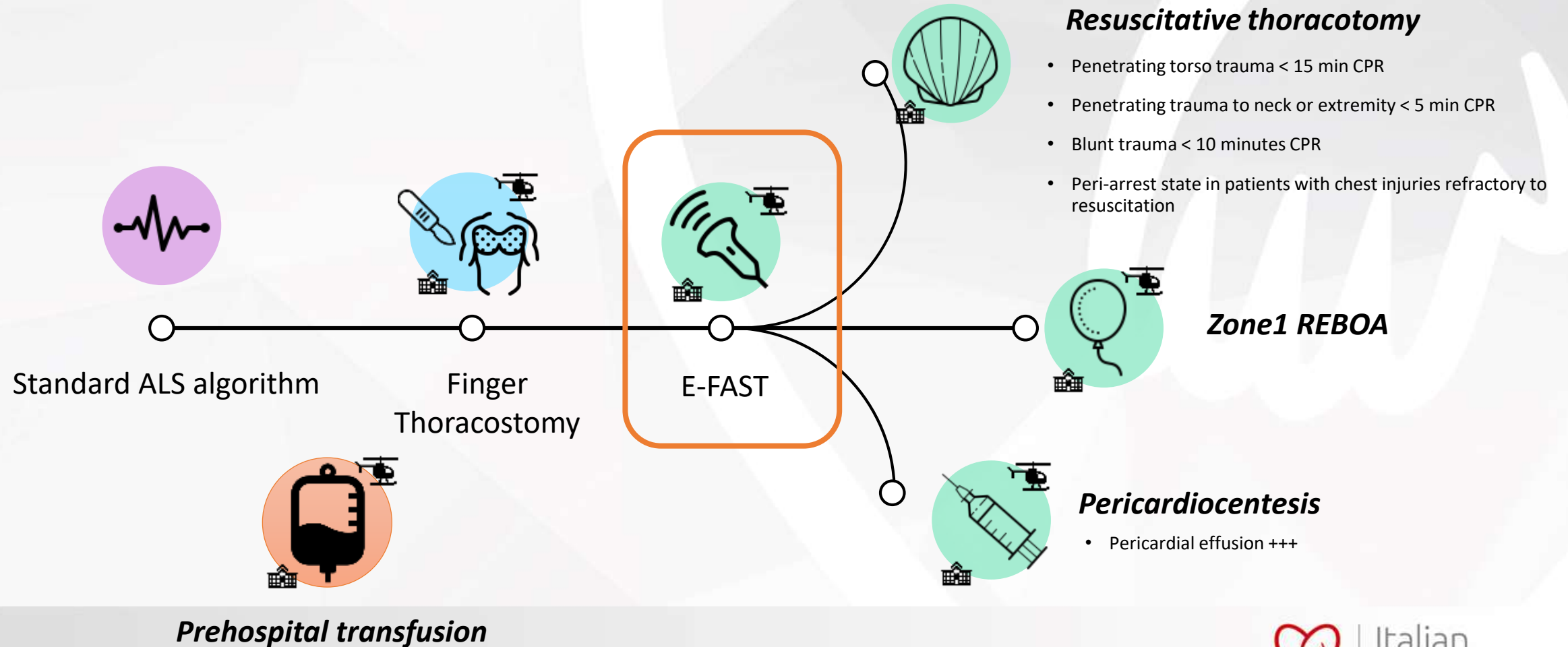


Fig. 1 - MAP at the Study End, the dashed line equates to ROSC.

Mortality ($\text{MAP} \leq 10$ mmHg) was significantly higher in Group 1 compared to Groups 2 and 3 ($P < 0.0001$). Resuscitation with whole blood was significantly better than saline ($P = 0.0069$), no animals in Group 3 attained ROSC. The addition of chest compressions to fluid resuscitation resulted in a significantly worse outcome with saline resuscitation ($P = 0.0023$) but not with whole blood ($P = 0.4411$). Cardiovascular variables at the end of the Resuscitation Phase and Study End were significantly worse for Group 5 compared to Group 3. Some significant differences were present at the end of the Resuscitation Phase for Group 4 versus Group 2 but these differences were no longer present by Study End. CCC were associated with increased mortality and compromised haemodynamics compared to intravenous fluid resuscitation. Whole blood resuscitation was better than saline.

Watts S et al. Closed chest compressions reduce survival in an animal model of haemorrhage-induced traumatic cardiac arrest. Resuscitation. 2019 Jul;140:37-42. doi: 10.1016/j.resuscitation.2019.04.048. Epub 2019 May 9. PMID: 31077754.

Algoritmo proposto



Ecografia

- Ricerca delle cause
- Attivazione delle risorse e dei percorsi in H
- Supporto alle decisioni di trattamento sulla scena

A – Intubazione corretta

B – Identificazione del PNX

C – Emoperitoneo, Tamponamento cardiaco, diametro v.cava, attività cardiaca, supporto all'incannulamento vascolare



PoCUS - Pro e contro

- Pro

- Portabilità
- Tempi di esecuzione rapidi: mediana 3 minuti
- Curva di apprendimento rapida
- Elevata specificità (Oltre il 90% per emoperitoneo)

- Contro

- Poche evidenze in preH
- Scarsa sensibilità (circa 50% per emoperitoneo)
- Aumento dei tempi sulla scena (?)

Attività cardiaca

TRAUMATIC CARDIAC ARREST

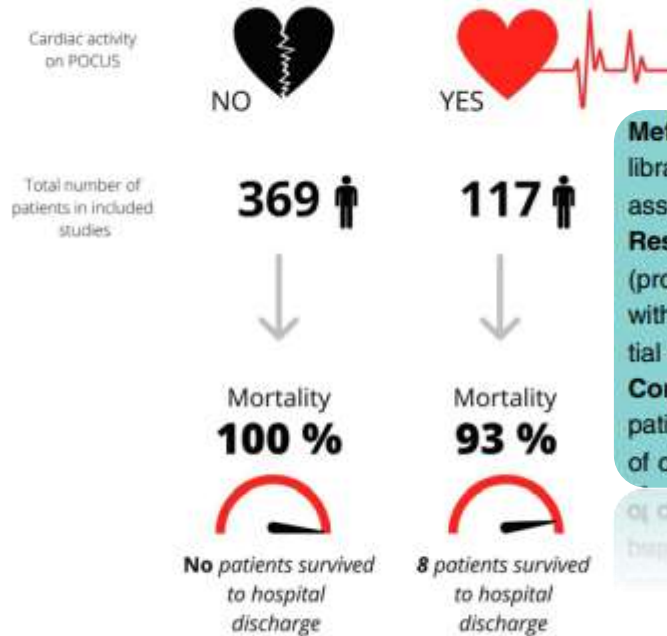


Fig. 2 – Infographic representation of traumatic cardiac arrest patient outcomes at hospital discharge based on sonographic cardiac activity.

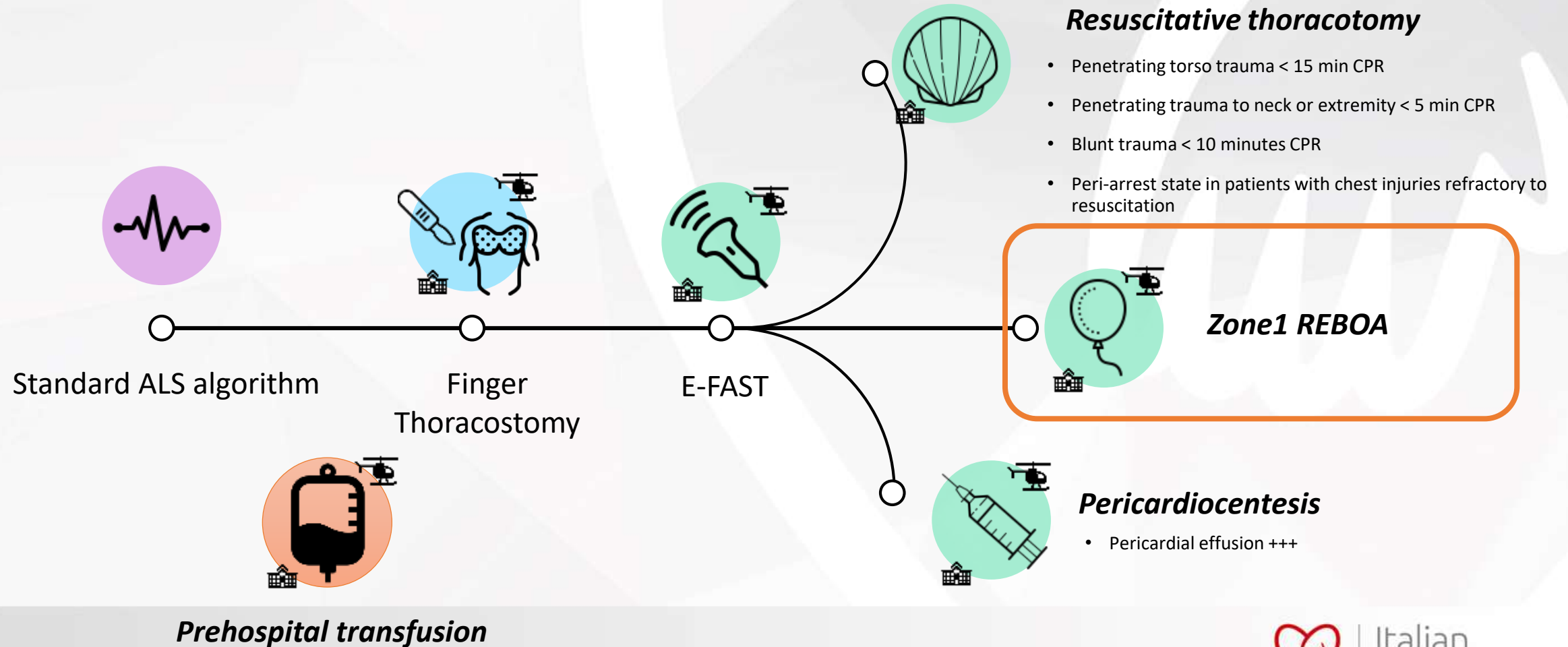
Methods: We conducted a systematic review and meta-analysis using the PRISMA guidelines. We searched Clinicaltrials.gov, CINAHL, Cochrane library, EMBASE, Medline and the World Health Organization-International Clinical Trials Registry from 1974 to November 9, 2020. Risk of bias was assessed using QUADAS-2 tool. We used a random-effects meta-analysis model with 95% confidence intervals with I^2 statistics for heterogeneity.

Results: We included 8 studies involving 710 cases of TCA. For all blunt and penetrating TCA patients who failed to achieve ROSC, the specificity (proportion of patients with cardiac activity on POCUS who achieved ROSC) was 98% (95% CI 0.13 to 1.0). The sensitivity (proportion of patients with cardiac standstill on POCUS who failed to achieve ROSC) was 91% (95% CI 0.67 to 0.98). No patient with cardiac standstill survived. Substantial level of heterogeneity was noted.

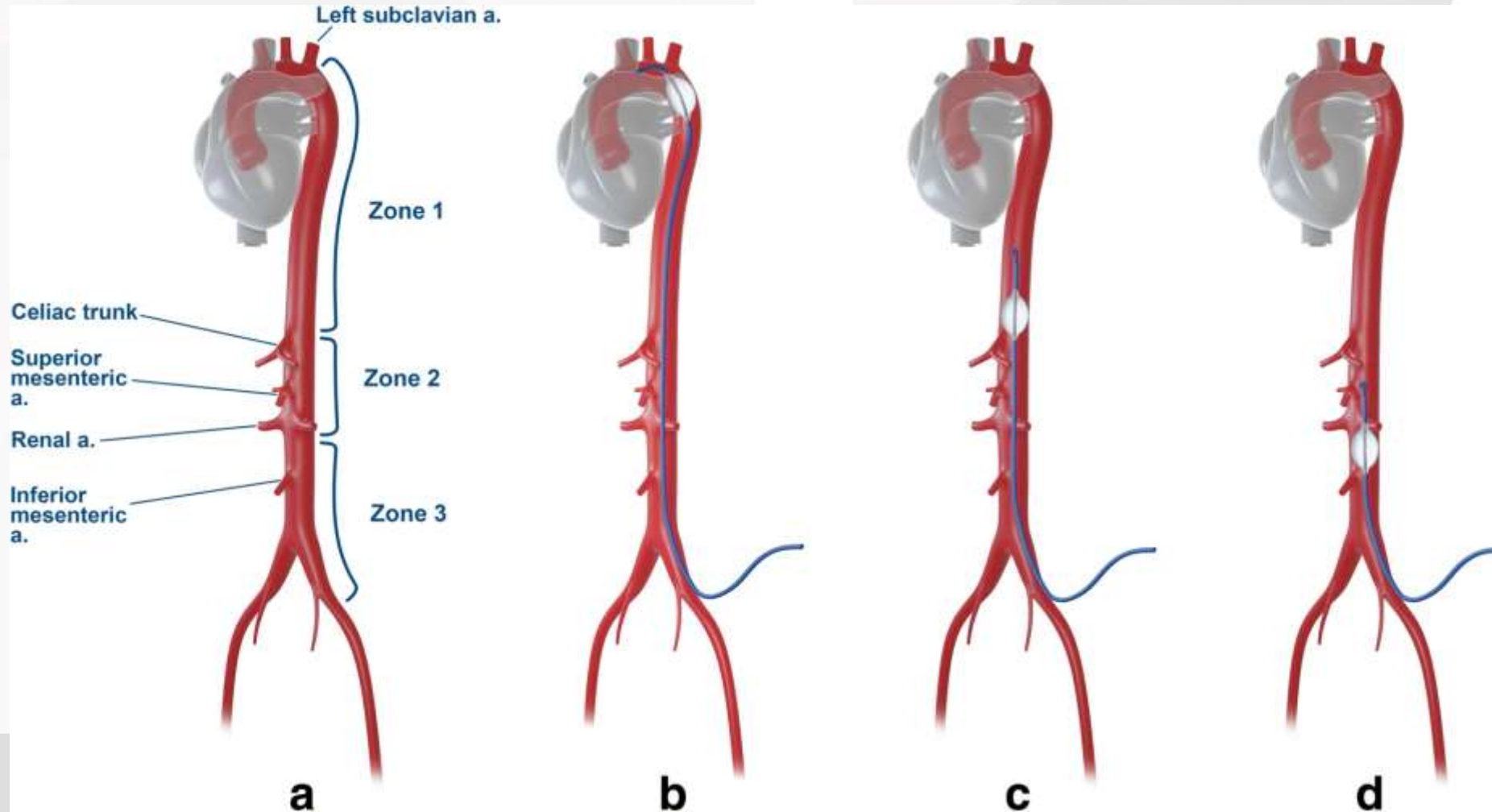
Conclusions: Patients in TCA without cardiac activity on POCUS have a high likelihood of death and negligible chance of SHD. The numbers of patients included in published studies remains too low for practice recommendations for termination of resuscitation based solely upon the absence of cardiac activity on POCUS.

Lalande E, Burwash-Brennan T, Burns K, Harris T, Thomas S, Woo MY, Atkinson P. Is point-of-care ultrasound a reliable predictor of outcome during traumatic cardiac arrest? A systematic review and meta-analysis from the SHoC investigators. *Resuscitation*. 2021 Oct;167:128-136. doi: 10.1016/j.resuscitation.2021.08.027. Epub 2021 Aug 23. PMID: 34437998.

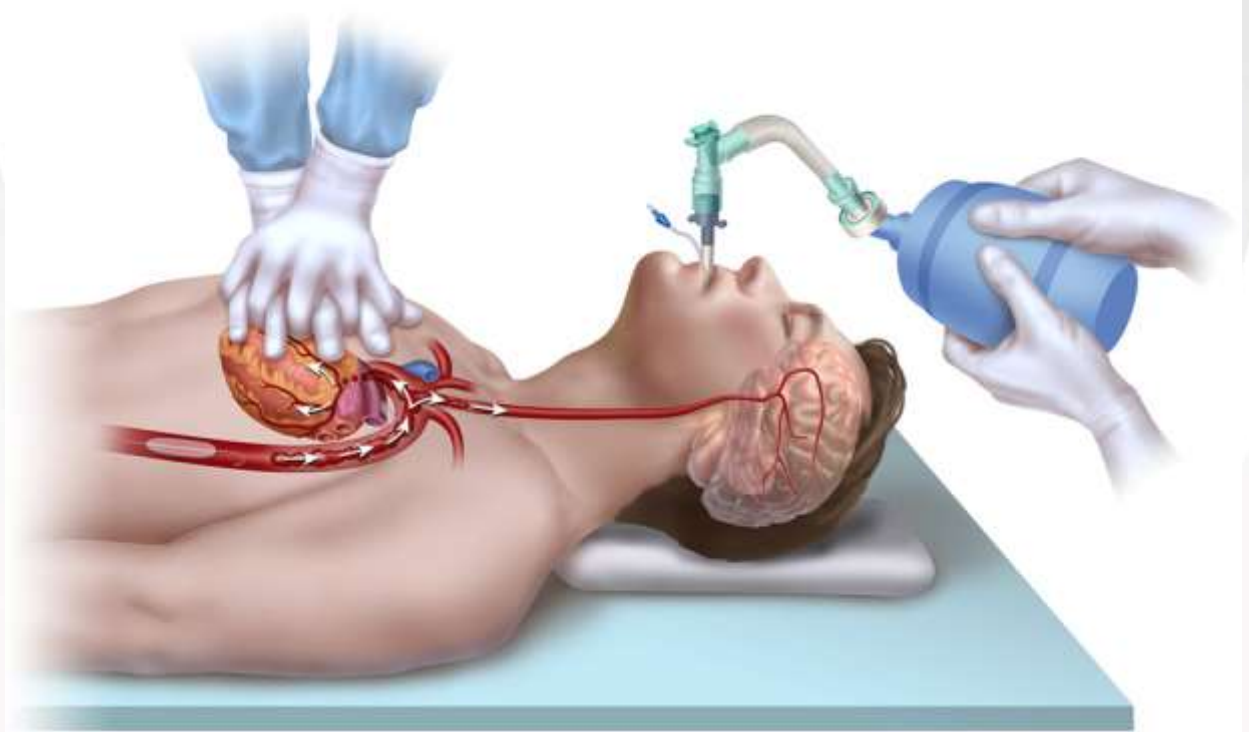
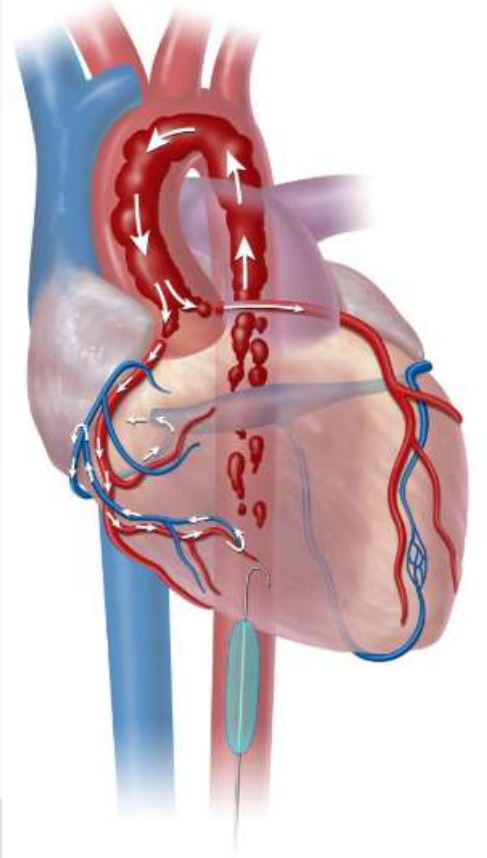
Algoritmo proposto



REBOA



REBOA



REBOA

- Vantaggi
 - Tecnica facile
 - Applicazione preospedaliera (EMS and HEMS) --> posizionamento precoce
 - Utile per interrompere i sanguinamenti degli arti inferiori e pelvi
- Svantaggi
 - Impossibilità di trattare direttamente le lesioni
 - Inutile per lesioni cardiache e toraciche
 - Rischio di danno all'Aorta e grandi vasi

Yamamoto et al.
Resuscitative endovascular balloon
occlusion of the aorta and traumatic out-
of-hospital cardiac arrest: A nationwide
study.
J Am Coll Emerg Physicians Open. 2020
Jul 4



Mortalità ospedaliera

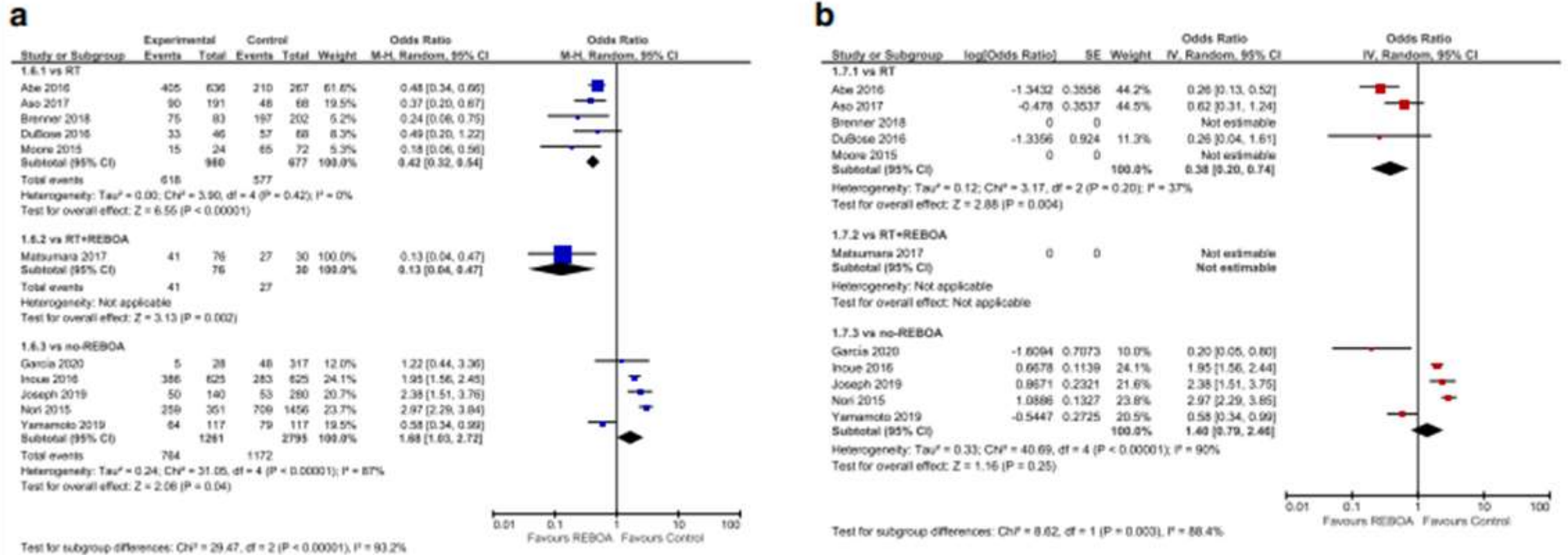
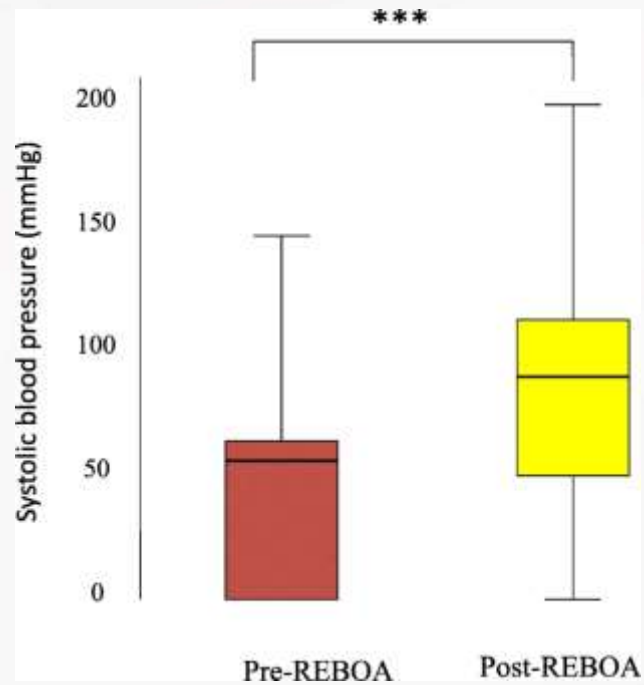


Fig. 1 a Overall crude odds ratios for in-hospital mortality (REBOA vs control – subgroups: vs RT; vs RT with REBOA; vs no-REBOA). **b** Overall adjusted odds ratios for in-hospital mortality (REBOA vs control — subgroups: vs RT; vs RT with REBOA; vs no-REBOA)

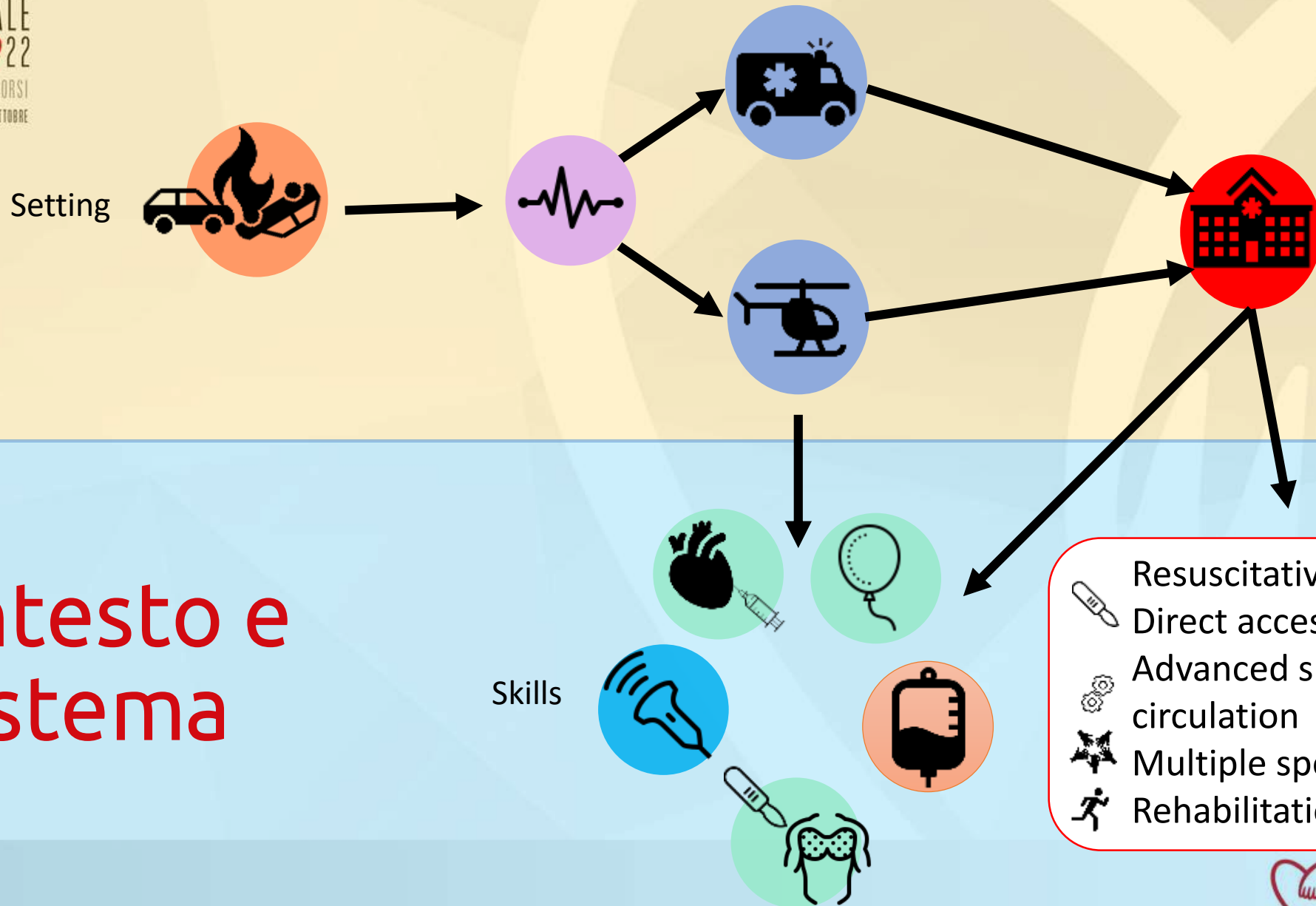
REBOA e TCA



- 26 patients
- RISC II Expected mortality: 97.7%
- Observed mortality: 73%
- $p = 0.049^*$

Hilbert-Carius, P., McGreevy, D.T., Abu-Zidan, F.M. *et al.*
Pre-hospital CPR and early REBOA in trauma patients — results from the ABOTrauma Registry.
World J Emerg Surg **15**, 23 (2020).





Contesto e Sistema

Italian Resuscitation Council

 ircouncil.it