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GRAND ROUNDS CLINICI DEL MERCOLEDÌ

con il Policlinico San Matteo

Aula Magna "C. Golgi" & WEBINAR

11/10/2024

«When the hospital goes to patient for saving a life: the ECPR on-site Study»

Mirko Belliato

Director of Cardiothoracic ICU and Anaesthesia

President of EuroELSO

ASAIO Journal 2021

Extracorporeal Cardiopulmonary Resuscitation in Adults. Interim Guideline Consensus Statement From the Extracorporeal Life Support Organization

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Reviewers: Robert Neumar, MD,*** Shingo Ichiba, MD,††† Thomas Mueller, MD,‡‡‡ Alain Combes, MD, PhD§§§

- e-CPR is the application of extracorporeal membrane oxygenation (ECMO) in patients where conventional cardiopulmonary resuscitation (CCPR) measures are unsuccessful in achieving a sustained return of spontaneous circulation (ROSC)
- e-CPR is a time-sensitive, complex intervention that requires teamwork, clearly defined roles, and well trained healthcare providers. It can be deployed both for patients with in-hospital cardiac arrest and out of hospital cardiac arrest (OHCA).

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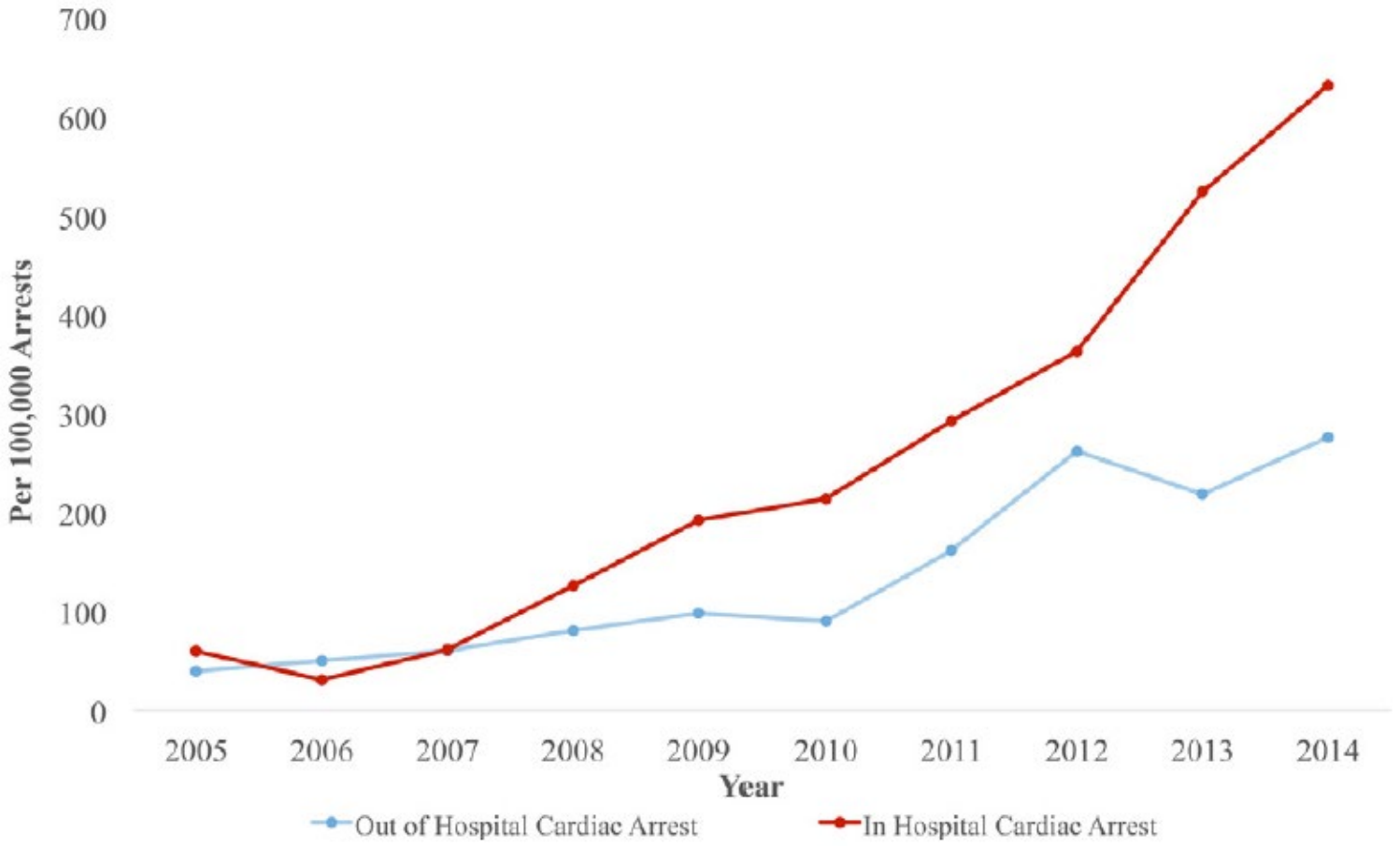
Extracorporeal Cardiopulmonary Resuscitation in Adults. Interim Guideline Consensus Statement From the Extracorporeal Life Support Organization

The time required to establish ECMO support is highly dependent upon the capabilities of the resuscitation team and patient factors. It may be achieved in as little as 10 minutes but may take longer.[9] We therefore advise early assessment for ECPR candidacy. It is reasonable to consider commencing cannulation after 10–20 minutes of failed resuscitation efforts. Beyond 20 minutes of refractory arrest, the probability of ROSC and survival with CCPR is <5%;[16,17] thus, the risks of V-A ECMO and ECPR at this point, with appropriately selected patients and providers, may be justified.

National trends in utilization and outcomes of extracorporeal support for in- and out-of-hospital cardiac arrest

Joseph Hadaya, Vishal Dobaria, Esteban Aguayo, Oh Jin Kwon, Yas Sanaiha, Ashley Hyunh, Sohail Sareh, Peyman Benharash *



RESUSCITATION 151 (2020) 181 –188

Recommendation

Circulation
Volume 142, Issue 16_Suppl_2, 20 October 2020, Pages S366-S468
https://doi.org/10.1161/CIR.0000000000000916

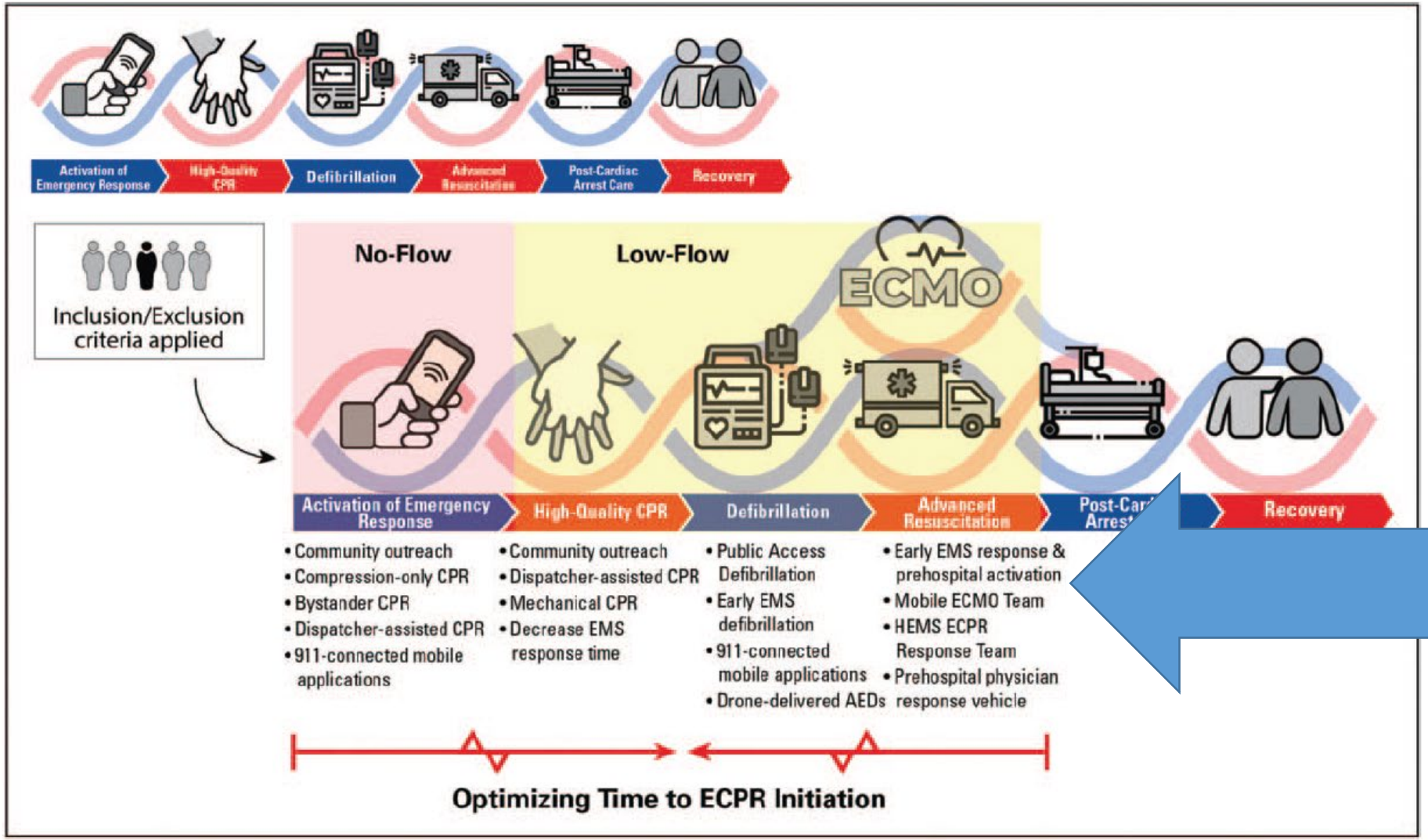
2020 AMERICAN HEART ASSOCIATION GUIDELINES FOR CARDIOPULMONARY RESUSCITATION AND EMERGENCY CARDIOVASCULAR CARE

Part 3: Adult Basic and Advanced Life Support: 2020 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care

Ashish R. Panchal, MD, PhD, Chair, Jason A. Bartos, MD, PhD, José G. Cabañas, MD, MPH, Michael W. Donnino, MD, Ian R. Drennan, ACP, PhD(C), Karen G. Hirsch, MD, Peter J. Kudenchuk, MD, Michael C. Kurz, MD, MS, Eric J. Lavonas, MD, MS, Peter T. Morley, MBBS, Brian J. O'Neil, MD, Mary Ann Peberdy, MD, Jon C. Rittenberger, MD, MS, Amber J. Rodriguez, PhD, Kelly N. Sawyer, MD, MS, and Katherine M. Berg, MD, Vice Chair

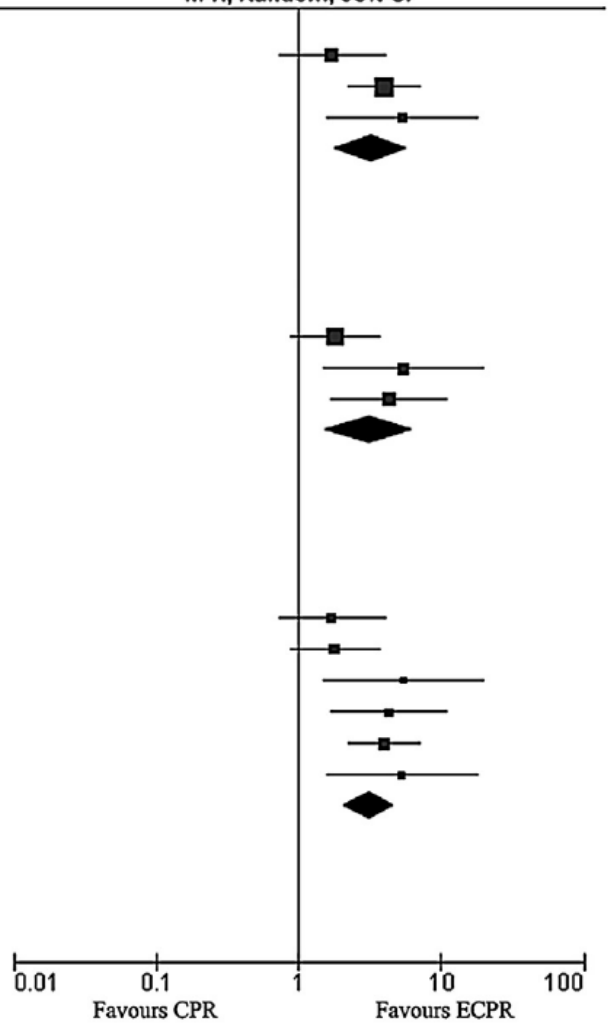
Recommendation for Extracorporeal CPR

COR	LOE	Recommendation
2b	C-LD	1. There is insufficient evidence to recommend the routine use of extracorporeal CPR (ECPR) for patients with cardiac arrest. ECPR may be considered for select cardiac arrest patients for whom the suspected cause of the cardiac arrest is potentially reversible during a limited period of mechanical cardiorespiratory support.



Extracorporeal CPR for out-of-hospital cardiac arrest *Gottula et al.*

Study or Subgroup	ECPR Events	ECPR Total	Traditional CPR Events	Traditional CPR Total	Weight	Risk Ratio M-H, Random, 95% CI
In-hospital cardiac arrest						
Chen 2008	9	59	10	113	32.5%	1.72 [0.74, 4.01]
Shin 2013	20	85	19	321	47.9%	3.98 [2.22, 7.10]
Siao 2015	8	20	3	40	19.6%	5.33 [1.58, 17.95]
Subtotal (95% CI)		**164**		**474**	**100.0%**	**3.21 [1.74, 5.94]**
Total events	37		32			
Heterogeneity: Tau² = 0.12; Chi² = 3.28, df = 2 (P = 0.19); I² = 39%						
Test for overall effect: Z = 3.72 (P = 0.0002)						
Out-of-hospital cardiac arrest						
Kim 2014	8	55	36	444	43.6%	1.79 [0.88, 3.66]
Maekawa 2013	8	53	3	109	22.6%	5.48 [1.52, 19.84]
Sakamoto 2014	29	258	5	193	33.8%	4.34 [1.71, 11.00]
Subtotal (95% CI)		**366**		**746**	**100.0%**	**3.11 [1.50, 6.47]**
Total events	45		44			
Heterogeneity: Tau² = 0.19; Chi² = 3.61, df = 2 (P = 0.16); I² = 45%						
Test for overall effect: Z = 3.04 (P = 0.002)						
In- or out-of-hospital cardiac arrest						
Chen 2008	9	59	10	113	17.2%	1.72 [0.74, 4.01]
Kim 2014	8	55	36	444	21.7%	1.79 [0.88, 3.66]
Maekawa 2013	8	53	3	109	8.8%	5.48 [1.52, 19.84]
Sakamoto 2014	29	258	5	193	14.9%	4.34 [1.71, 11.00]
Shin 2013	20	85	19	321	27.7%	3.98 [2.22, 7.10]
Siao 2015	8	20	3	40	9.7%	5.33 [1.58, 17.95]
Subtotal (95% CI)		**530**		**1220**	**100.0%**	**3.11 [2.06, 4.69]**
Total events	82		76			
Heterogeneity: Tau² = 0.07; Chi² = 6.90, df = 5 (P = 0.23); I² = 28%						
Test for overall effect: Z = 5.39 (P < 0.00001)						



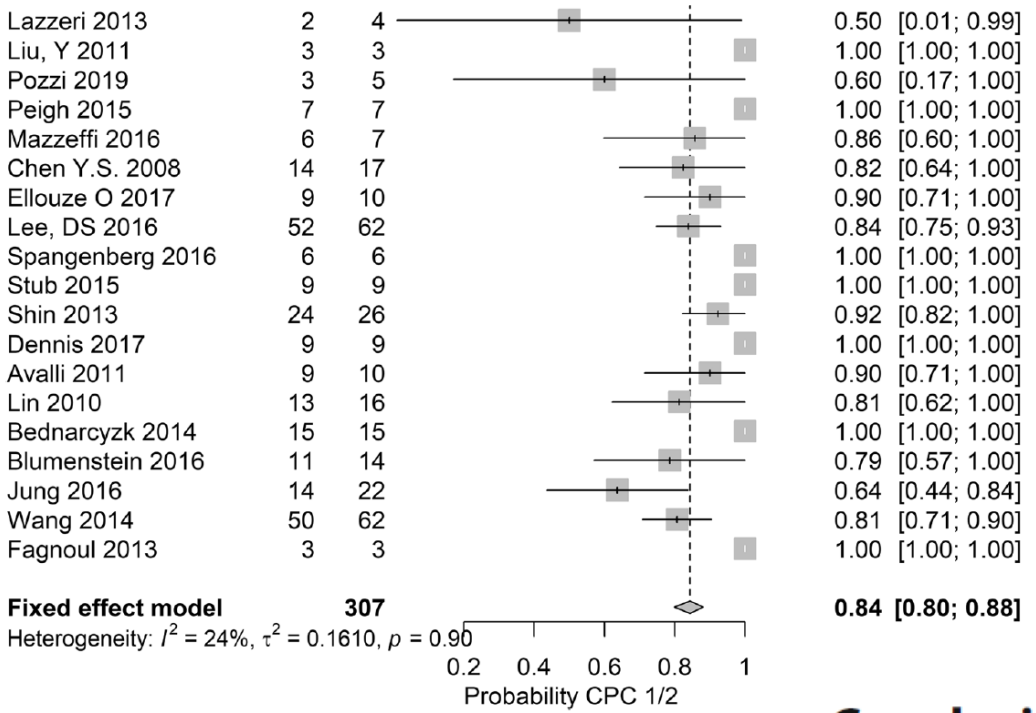


Fig. 2 Forest plot showing the results for the primary outcome of this study, neurological outcome

Conclusion

ECPR as treatment for in-hospital cardiac arrest is associated with a large proportion of patients with good neurological outcome (CPC 1–2). The large proportion of favourable outcome could potentially be explained by the selection of patients for treatment using ECPR.

ORIGINAL

Extracorporeal r
for refractory ca
multicenter stu

Dirk Lunz[1], Lorenzo Calabrò[2,3], Mirk
Daniel Patricio[3], Maximilian Malferth
and Federico Pappalardo[2]

	All patients (*n* = 423)	FO (*n* = 80)	UO (*n* = 343)
Demographics			
Age (years)	57 (48–65)	60 [49–66]	56 [48–65]*
Body weight (kg)	80 (70–90)	75 [65–80]	80 [70–90]
Male gender, *n* (%)	330 (78)	58 (73)	272 (79)
Comorbid diseases			
Heart disease, *n* (%)	167 (39)	45 (56)	122 (36)*
Diabetes, *n* (%)	35 (8)	5 (6)	30 (9)
COPD/asthma, *n* (%)	24 (6)	2 (3)	22 (6)
Chronic renal disease, *n* (%)	15 (4)	2 (3)	13 (4)
Liver cirrhosis, *n* (%)	6 (1)	0 (0)	6 (2)
Cancer, *n* (%)	18 (4)	2 (3)	16 (5)
Immunosuppressive agents, *n* (%)	17 (4)	5 (6)	12 (3)
Cardiac arrest characteristics			
Cardiac origin, *n* (%)	307 (73)	61 (76)	246 (72)
Bystander CPR, *n* (%)	345 (82)	77 (96)	268 (78)*
Initial shockable rhythm, *n* (%)	263 (62)	63 (79)	200 (58)*
Mechanical CPR, *n* (%)	374 (88)	70 (88)	304 (89)
Total adrenaline dose, mg	7 [5–10]	5 [4–8]	8 [5–10]*
Number of defibrillations	2 [0–5]	2 [0–4]	2 [0–5]
Pre-hospital hypothermia, *n* (%)	20 (5)	4 (5)	16 (5)
Time from arrest to ECMO, min	67 [45–85]	38 [20–60]	70 [53–90]*
ECMO characteristics			
Initial ECMO blood flow (L/min)	3.9 [3–4.6]	3.2 [2.7–3.9]	4.0 [3.2–4.8]
Initial ECMO oxygen concentration (%)	100 [100–100]	100 [100–100]	100 [100–100]
Initial ECMO sweep flow (L/min)	4 [3–5]	4 [2–5]	4 [3–6]
Peripheral cannulation, *n* (%)	406 (96)	77 (96)	329 (96)
Duration of ECMO, days	2 [1–4]	4 [3–6]	2 [1–3]*
Dobutamine therapy during ICU stay, *n* (%)	324 (77)	58 (73)	266 (78)
Vasopressin during ICU stay, *n* (%)	17 (4)	1 (1)	16 (5)
Lactate on admission (mEq/L)	12.2 [7.8–17]	7.8 [5–11.9]	13.1 [9–18.2]*
Peak of lactate (mEq/L)	12.6 [8.3–18]	8.8 [5.8–12.1]	13.7 [9.1–18.5]*

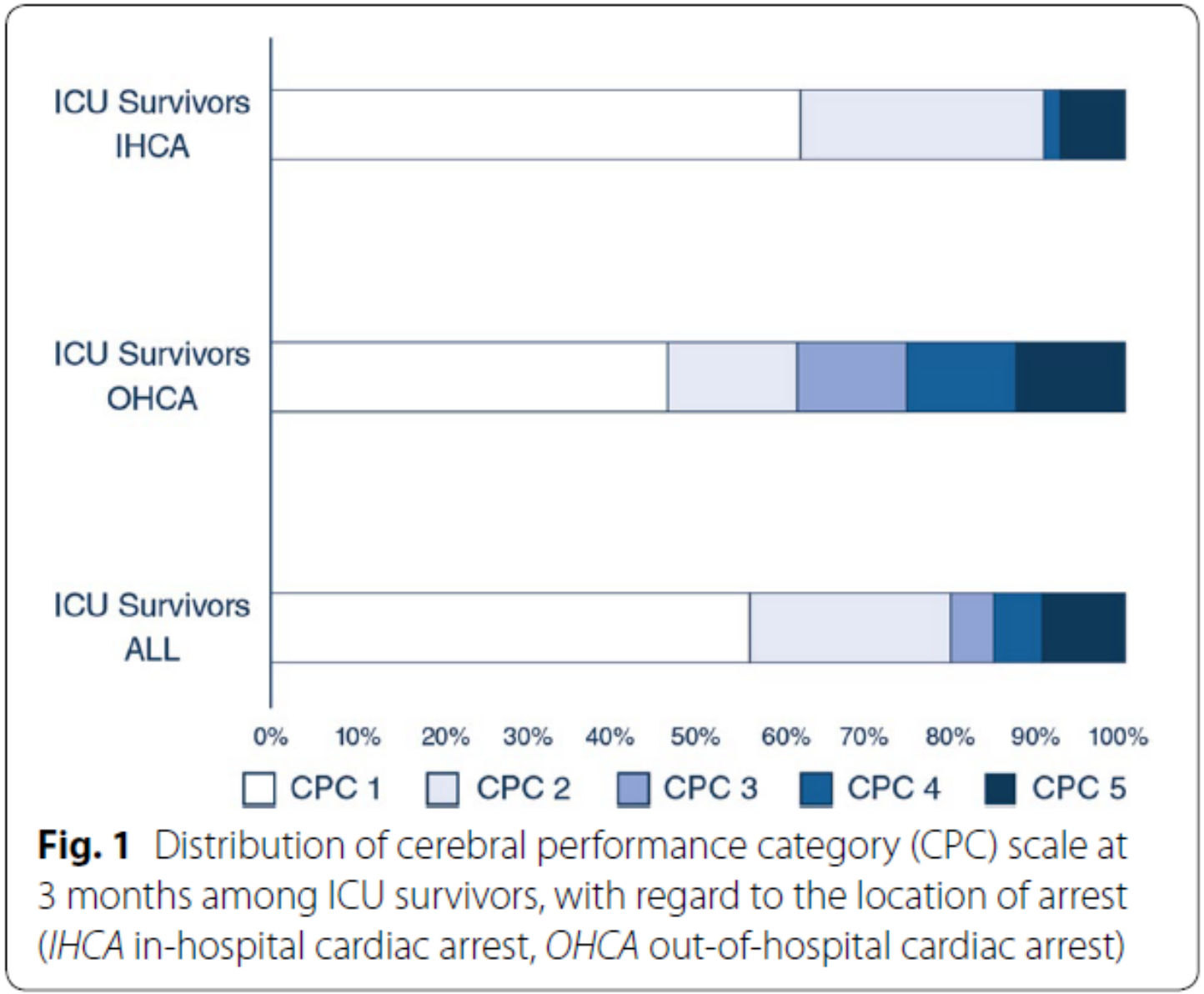


Fig. 1 Distribution of cerebral performance category (CPC) scale at 3 months among ICU survivors, with regard to the location of arrest (*IHCA* in-hospital cardiac arrest, *OHCA* out-of-hospital cardiac arrest)

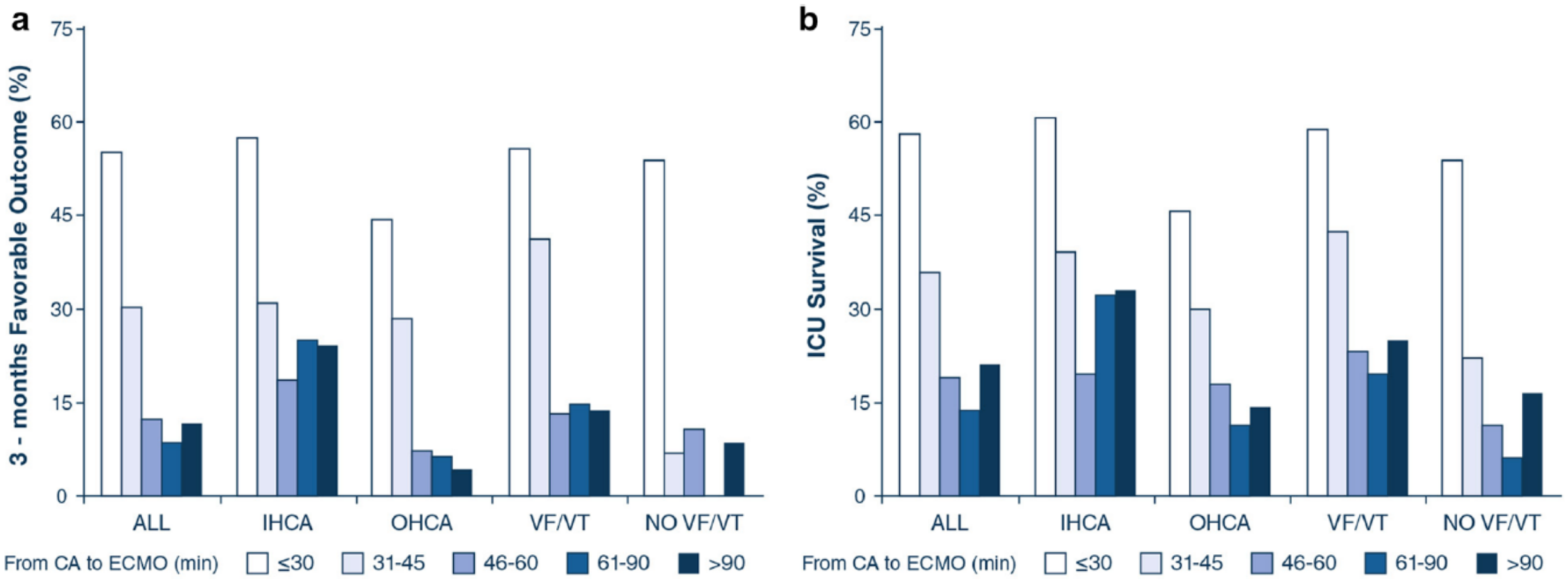
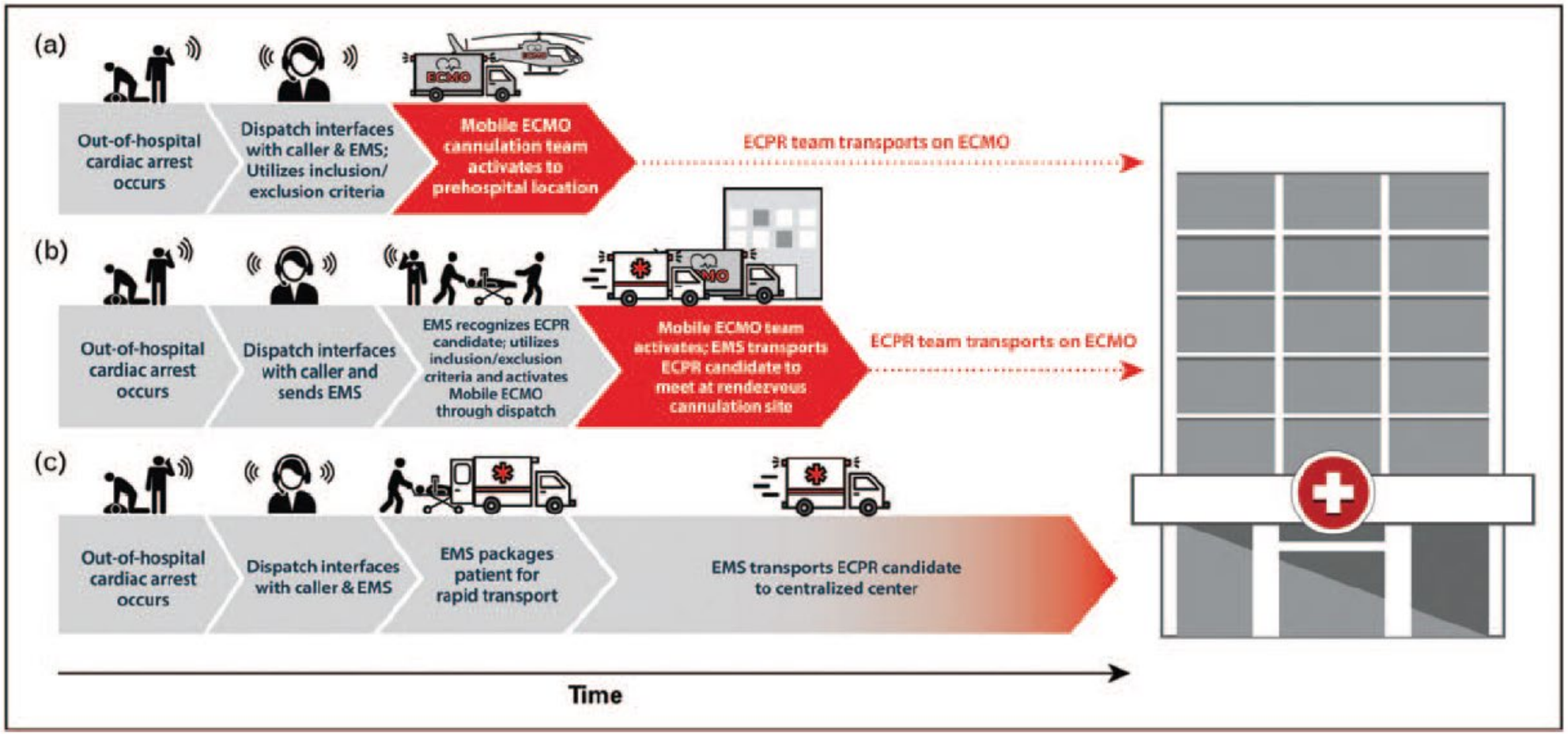


Fig. 3 Relation between time to ECMO and the favorable neurological outcome rate (**a**) or ICU survival (**b**). *IHCA* in-hospital cardiac arrest, *OHCA* out-of-hospital cardiac arrest; initial shockable (VF/VT) or non-shockable (no VF/VT) rhythm

Take-home message

In a large cohort from five European ECMO centers, the use of ECPR was associated with 19% of favorable neurological outcome at 3 months, 9% for out-of-hospital and 34% for in-hospital arrest. Moreover, the use of stringent selection criteria was associated with 38% of favorable neurological outcome.



Extracorporeal CPR for out-of-hospital cardiac arrest Gottula *et al.*

The Regional Act to create a Hub & Spoke Network for Cardiogenic Shock and Out of Hospital Cardiac Arrest

RegioneLombardia
LA GIUNTA

DELIBERAZIONE N° XI / 2562 Seduta del 02/12/2019

Oggetto

ULTERIORI DETERMINAZIONI IN MERITO ALL'APPLICAZIONE DELLA METODICA ECMO (EXTRA CORPOREAL MEMBRANE OXYGENATION): INDIVIDUAZIONE DEI CENTRI REGIONALI PER IL TRATTAMENTO DELLO SHOCK CARDIOGENO O ARRESTO CARDIACO REFRATTARIO E DELLA SINDROME DA INSUFFICIENZA RESPIRATORIA ACUTA GRAVE

- Rete regionale per il trattamento dei pazienti in shock cardiogeno o arresto cardiaco refrattario:
  - ✓ Fondazione IRCCS Policlinico San Matteo, Pavia,
  - ✓ ASST Grande Ospedale Metropolitano Niguarda, Milano con specificità per i pazienti in età pediatrica,
  - ✓ IRCCS Ospedale San Raffaele, Milano,
  - ✓ ASST Papa Giovanni XXIII, Ospedale di Bergamo, Bergamo con specificità per i pazienti in età pediatrica,
  - ✓ ASST di Monza, Ospedale San Gerardo, Monza,
  - ✓ Fondazione IRCCS Ospedale Maggiore Policlinico, Milano,
  - ✓ ASST Fatebenefratelli Sacco (P.O. Sacco), Milano,
  - ✓ ASST dei Sette Laghi, Varese,
  - ✓ ASST degli Spedali Civili di Brescia, Brescia,
  - ✓ ASST Ovest Milanese, Legnano (MI),
  - ✓ Istituto Clinico Humanitas, Rozzano (MI),

Rete regionale per la gestione del trattamento ECMO in pazienti in shock cardiogeno o arresto cardiaco refrattario

LIVELLO	CARATTERISTICHE
1	Struttura sanitaria con Terapia Intensiva Cardiologica
2	Struttura sanitaria in grado di gestire il trattamento ECMO con accesso a terapie short term
3	Strutture di riferimento regionale in grado di gestire il trattamento ECMO con accesso a terapie long term e/o trapianto (in sede o in rete) e di attivare un ECMO team mobile (24/24 e 7/7)

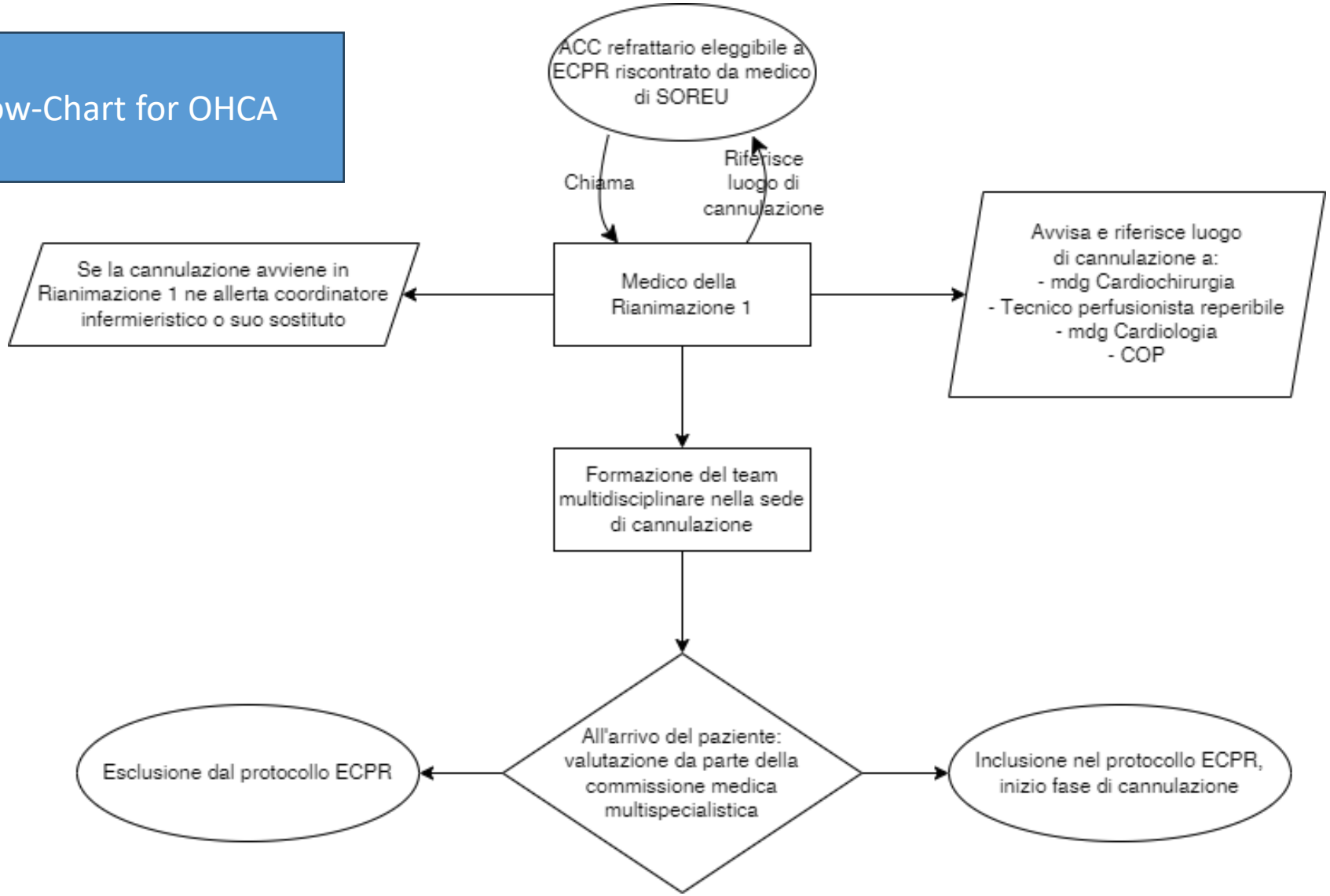
Level 3: Institution with ECMO facilities 24/7 and Heart transplantation or VAD capability

I centri di 3 livello devono rispettare le seguenti caratteristiche strutturali/organizzative:

- Disponibilità ECMO team mobile per incannulamento/trasporto 24/24 e 7/7 (anche tramite reperibilità)
- Disponibilità ricovero in ambiente intensivo 24/24
- Servizio di Emodinamica h24 e 7/7
- Disponibilità di un cardiologo ed un ecocardiografista h24 e 7/7
- Divisione di Cardiochirurgia
- Divisione di Chirurgia vascolare
- Possibilità di upgrading a supporto circolatorio meccanico long term e/o trapianto cardiaco
- Team multidisciplinare per impianto e gestione LVAD in classe INTERMACS 1 (MCS team)

Mobile-ECMO team for patient retrieval 24/7

Flow-Chart for OHCA

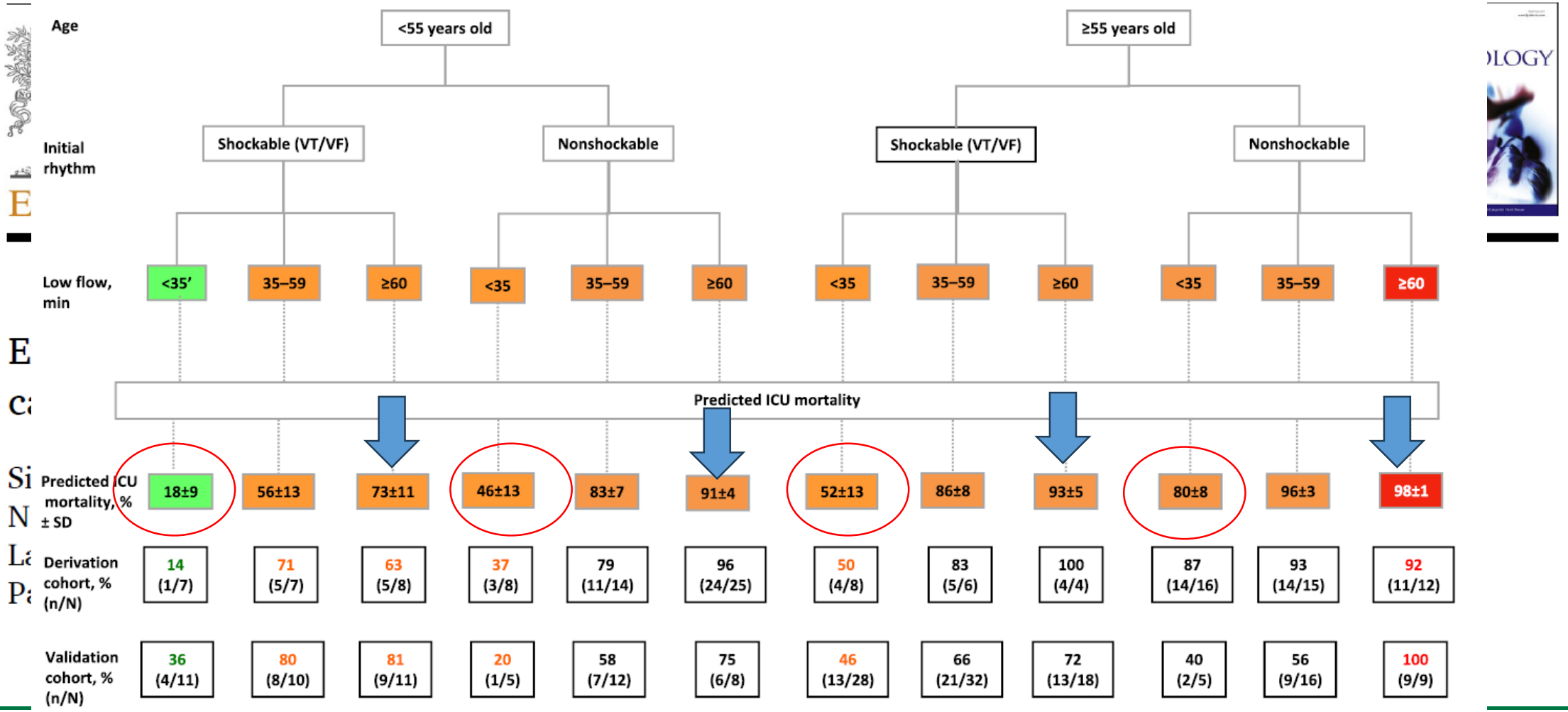


2.1 Indicazioni e condizioni necessarie all'arruolamento

1. Anamnesi (nota al momento dell'arrivo in ospedale) muta per patologie sistemiche invalidanti gravi e/o croniche degenerative di un organo diverso dal cuore;
2. Età ≤ 65 anni;
3. Disponibilità ed utilizzo di un sistema automatico per massaggio cardiaco esterno (es. Autopulse o Lucas, o similare);
4. Arresto cardiaco refrattario alla rianimazione cardiopolmonare, cioè sottoposto ad rianimazione cardiopolmonare efficace per almeno 15 min. e 3 mg di adrenalina, e dopo tentativo di correzione di eventuali fattori concomitanti (se presenti) come tamponamento cardiaco, pneumotorace, ipovolemia, etc;
5. Le manovre di rianimazione cardiopolmonare (RCP) devono essere di alta qualità cioè essere eseguite da personale qualificato e secondo le linee guida ACLS, con ventilazione efficace (certezza di ventilazione ed ossigenazione), $EtCO_2$>15 mmHg ed ottenuto con adeguato volume tidal (Vt/Kg ≈ 6 ml/Kg), assenza di deformazioni toraciche significative che possano impedire un adeguato massaggio cardiaco esterno, linea infusiva intravenosa o intraossea posizionata e ben funzionante;
6. Il momento esatto in cui è avvenuto l'ACC deve essere noto e ben identificato, registrato e comunicato a chi attiva l'ECMO Team, si vedano la flow chart rispettivamente per intra- ed extra-ospedaliero;

7. Conferma all'arrivo in ospedale di un tempo di No-Flow < 5 min. (cioè tempo di assenza di massaggio cardiaco esterno giudicato efficace dal primo soccorritore certificato o MCE eseguito secondo efficaci Istruzioni Pre Arrivo effettuate dalla SOREU) oppure devono essere presenti segni vitali all'arrivo del primo soccorritore professionale (gasping, riflessi di tronco presenti o movimenti degli arti) oppure si vedano le condizione "ad hoc" paragrafo 2.3;
8. Conferma all'arrivo in ospedale di un tempo di Low-Flow extraospedaliero, cioè da ACC - ad inizio cannulazione < 60 min. (si intende tempo di low flow continuativo sotto MCE in assenza di ripresa di attività cardiaca e spontanea efficace certa, in caso di ROSC e successivo ACC i tempi vanno ricalcolati).

International Journal of Cardiology 350 (2022) 48–54




SOUNDS GOOD, DOESN'T WORK
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ECMO onSite: a prehospital eCPR program for the Pavia Province and a simulation of its potentiality

Purpose of the study

Refractory Out-of-Hospital Cardiac Arrest (OHCA) is a significant issue with meager survival. eCPR is a technique that offers chances to these patients, requiring a limited time window to start the procedure (low-flow time lower than 45'). Due to the high skills needed to start eCPR is only available in specialized hospitals. The distance of the OHCA site from these facilities is the main limitation, affecting the low-flow time.

We designed a pre-hospital eCPR program and simulated its potential benefit.

Material and Methods

We have analyzed six years of **our cardiac arrest registry** and selected patients who match dispatch criteria and have not achieved ROSC to evaluate if the pre-hospital eCPR-team could offer eCPR support to an increased number of patients and in less time.

We used real arrival time on the scene of the ALS medical team and simulated the time of the eCPR-team using Google Maps routing, which decreased by 15% of the time due to the emergency drive and added 5 minutes for activation time.

Results

On 275 patients, the pre-hospital eCPR-team could start cannulation within 45' from OHCA in 233 patients, compared to only 66 patients who could arrive at ECMO Hospital in the same time window, the median time from OHCA to cannulation start is 34' for both.

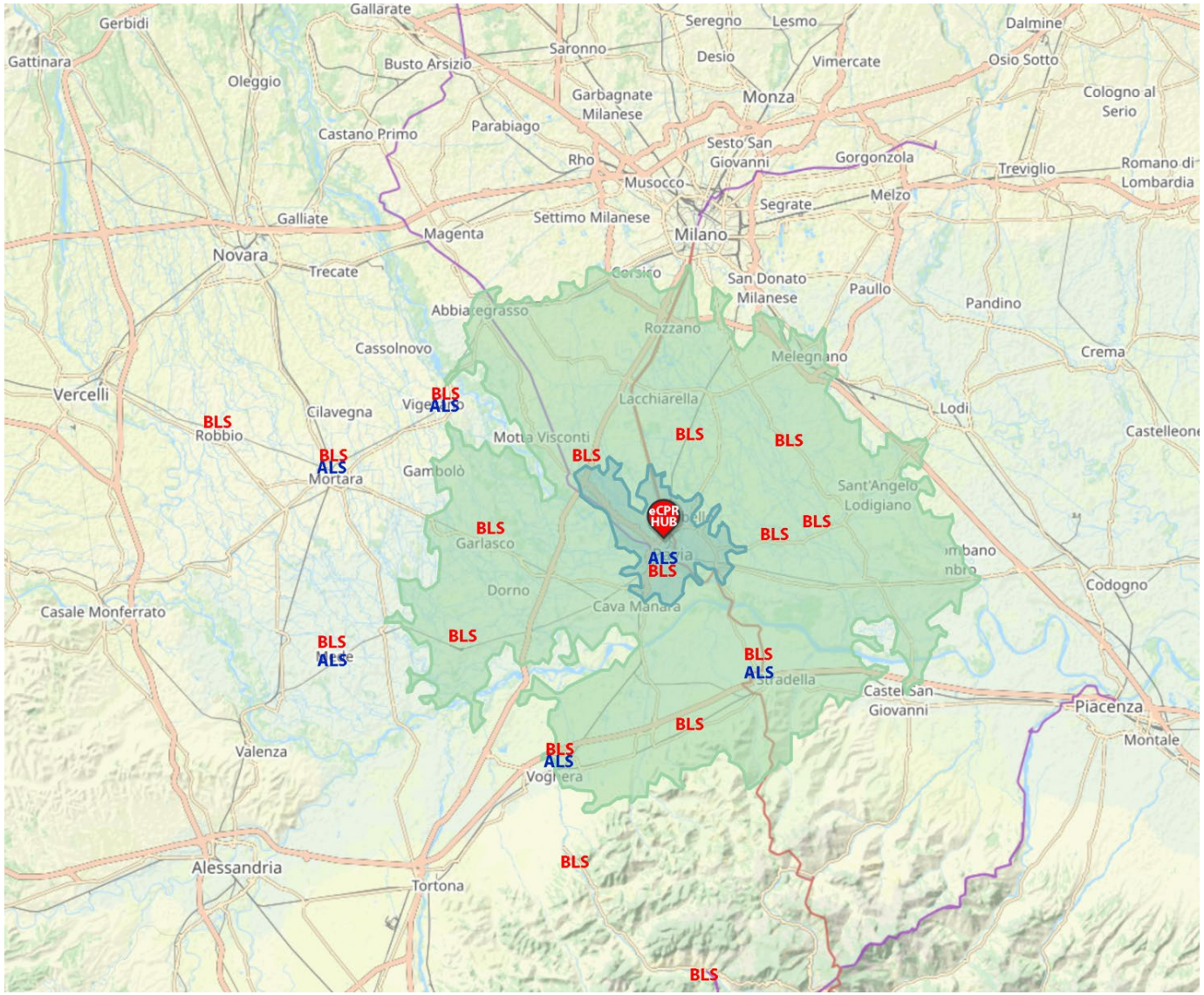

Figure 1:

Map of the area in which OHCA patients ***could be eligible*** *for* ***standard ECPR (dark green)*** *vs estimated area of activity of the mobile ECPR Team (light green).*

BLS: BLS ambulance location | ALS: ALS rapid response vehicle location –| eCPR Hub: IRCCS Policlinico San Matteo ECMO center and location of the Mobile eCPR Team

The Partnesrship:

Fondazione IRCCS Policlinico San Matteo

Sistema Socio Sanitario

Regione Lombardia

AREU

Sistema Socio Sanitario

Regione Lombardia

118 Soccorso Sanitario

Emergenza 112

Fondazione della Comunità

della Provincia di Pavia - Ente Filantropico

EUROSETS

EVERY LIFE MATTERS

Feasibility Study on a Prehospital extracorporeal CardioPulmonary Resuscitation in the Pavia's Province. An interventional study on complex treatment strategy (ECPR ONSITE)"

The objective of this study is to investigate the feasibility of a prehospital eCPR program in the context of the Pavia province in order to reduce the time from cardiac arrest to organ reperfusion with the farthest aim of improving survival and good neurologic outcomes of patient victims of refractory cardiac arrest.

The primary endpoint is the number of successful eCPR placed in prehospital settings over patients that meet inclusion criteria. The secondary outcomes are:

- the cause of cannulation failure and the proportion of cannulation feasibility according to the implant site;
- to evaluate eCPR Team performance to better design a definitive institutional eCPR program

Inclusion / Exclusion criteria:

The population of the study is composed of patients who are victims of a witnessed refractory cardiac arrest in the province of Pavia. Inclusion criteria:

- out-of-hospital cardiac arrest occurred in Pavia province
- the age of the patient is between 18 and 75
- witnessed cardiac arrest
- CPR started within 5 minutes of the patient's collapse or presence of gasping at the arrival of the ACLS team
- eCPR team arrived within 60 minutes of the patient's collapse
- etCO2 ≥ 10 mmHg
- mechanical chest compression is ongoing
- refractory cardiac arrest after at least 15 minutes of ACLS
- Patients will be excluded if they had a modified Rankin Scale ≥ 3, if cardiac arrest ha traumatic origin, if the suffer of advanced pulmonary illness or end-stage neoplasm.

The team leader is cardiosurgeon

ECMO Team Mobile

The eCPR Team comprises the same professionals currently involved in the in-hospital program:

Cardiac Surgeon,

Perfusionist

ACLS team (to perform ordinary care during cannulation)

The eCPR team is transported to the patient with a dedicated rapid response vehicle conducted by a professional emergency driver, that is adapted for cannulation (as a mobile operative room)

After an emergency call is received for a patient with a cardiac arrest that meets eCPR dispatch criteria, BLS, ACLS and the eCPR Team will be sent to the patient.

The BLS and ACLS Teams are capillary distributed on the territory of the Pavia province, so they will usually arrive before the eCPR Team.

When the eCPR Team arrives at the patients, inclusion and exclusion criteria will be evaluated. If eligible for treatment, eCPR will be implanted in a prehospital setting and then transferred to San Matteo Hospital.

On scene

BLS

EMS Ambulance with 2 or 3 certified rescuers

To treat the CA with BLS-D support

ACLS Team / MSA2

- ACLS Team, or «MSA2»
  - Physician (Intesivist or Emergency)
  - Nurse
  - Diver/Em Techinician
- To treat the patient with the ACLS and to prepare for cannulation.

eCPR Mobile Team

eCPR Team Mobile :

- Cardiochirurgo
- Perfusionist
- Diver/Em Technicians

To cannulate (VA ECMO, femoro-femoral access).

Crucial features

- Pre-hospital setting (small spaces, reduced materials , less personell and Ambiental discomfort)
- VA ECMO implantation on an ambulance (that has prepared as much as possible, but still remain a small place)
- Relatives on site, psychological issues, communication to the bystanders

ACLS

- L'esecuzione dell'ACLS è standard, compreso del blocco del ganglio stellato di sinistra per i casi di FV/TVsp refrattarie o recidivanti.
- Come previsto dalle attuali Linee Guida in cui viene sottolineato di evitare alte dosi di adrenalina, ci si impone un limite a 5mg di adrenalina complessivi.
- Come sempre è necessario posizionare l'etCO_2 preferibilmente con IOT ma in casi di intubazione difficile è possibile l'impianto anche con LMA se l'etCO_2 è ben leggibile e la ventilazione affidabile.
- Come sempre è necessario che il paziente sia massaggiato meccanicamente, massaggiatore da posizionare il prima possibile al fine di garantire alta qualità delle compressioni, non dipendente dagli operatori e dalla fatica degli operatori.

Durante l'impianto ECMO

Nella fase di impianto, l'obiettivo è arrivare all'avvio pompa nel minor tempo possibile. Come da Linee Guida ELSO:

- È ragionevolmente indicato sospendere le defibrillazioni, al fine di evitare continue interruzioni dell'impianto per il rischio **elevato** di elettrocuzione degli operatori (guide metalliche).
- È ragionevolmente indicato sospendere i controlli di ritmo: per quanto possibili a discrezione del team leader ACLS, l'interruzione dell'Autopulse può rendere necessaria la calibrazione dell'albero delle bande, che dovrà essere svolta dal medico in autonomia (evitando di interferire con il campo)
- Si sospende la somministrazione di adrenalina, anche se non raggiunti i 5mg (raro!), per evitare la rapida circolazione del bolo all'avvio della pompa

Start before the end of the year

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