PACIENT NÁM NECHCE NASKOČIT… CALL FOR ECPR

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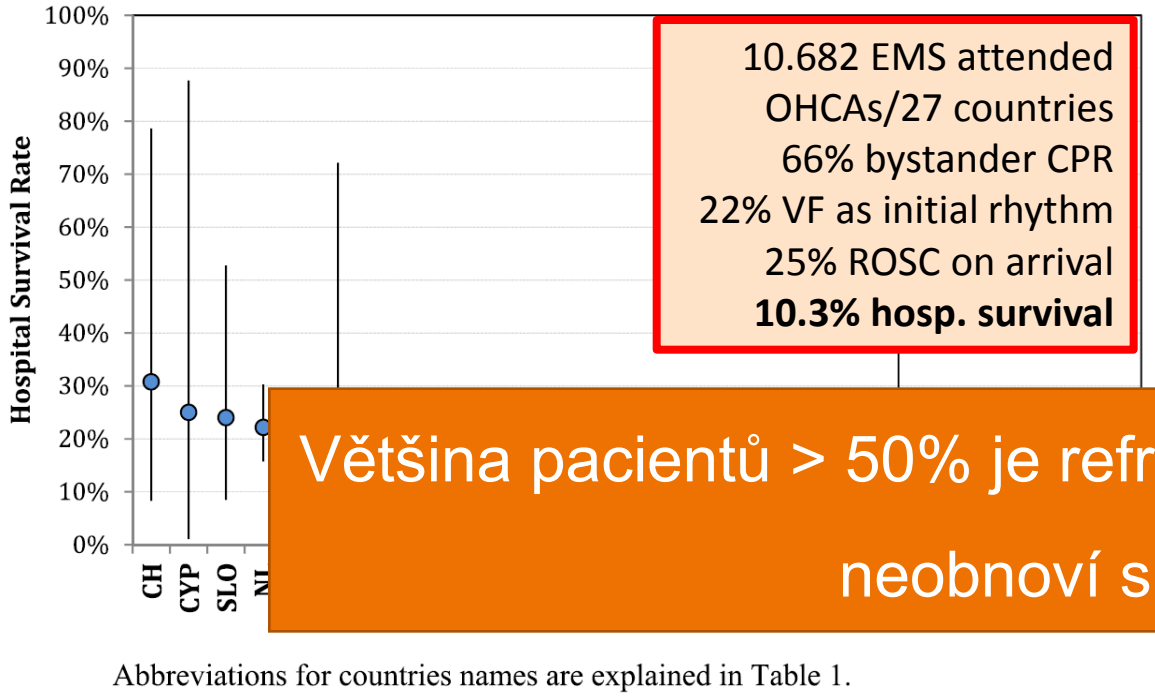
Co je ECPR v užším slova smyslu?

= the application of **rapid-deployment** VA-ECMO to provide circulatory support in patients in whom **conventional CPR is unsuccessful** in achieving **sustained ROSC**

Richardson ASC, Tonna JE, Nanjayya V, et al. Extracorporeal cardiopulmonary resuscitation in adults. Interim guideline consensus statement from the extracorporeal life support organization. ASAIO J 2021;67(3):2218.

Proč potřebujeme ECPR ?

10.682 EMS attended OHCAs/27 countries
66% bystander CPR
22% VF as initial rhythm
25% ROSC on arrival
10.3% hosp. survival



Abbreviations for countries names are explained in Table 1.

Fig. 4. Percentage survival in cases with CPR attempted (discharged from hospital alive or alive at least 30 days after event). The vertical lines represent the 95% confidence intervals. The graph includes 6414 patients from 27 countries (range 4 – 1218). The overall rate is 10.3%. Abbreviations for countries names are explained in Table 1.

Většina pacientů > 50% je refrakterní ke konvenční resuscitaci a neobnoví spontánní oběh.

Gräsner, J. T., Lefering, R., Koster, R. W., Masterson, S., Böttiger, B. W., Herlitz, J., ... & Zeng, T. (2016). Resuscitation, 105, 188-195.

Grunau, B., Reynolds, J., Scheuermeyer, F., Stenstom, R., Stub, D., Pennington, S., ... & Christenson, J. (2016). Prehospital Emergency Care, 20(5), 615-622.

Jaké jsou výsledky pacientů bez ROSC přivezených do nemocnice bez ECMO ?

4%

96%

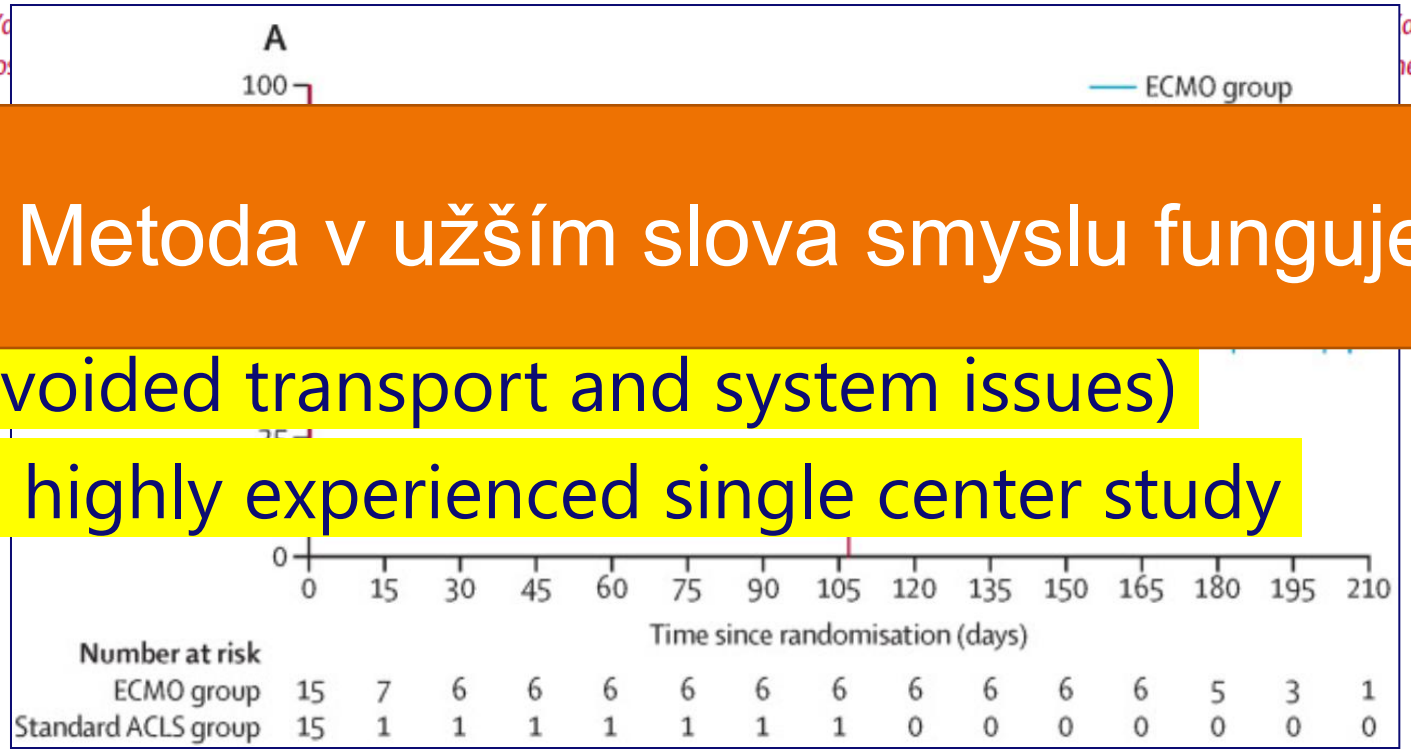
- Wampler, D. A., Collett, L., Manifold, C. A., Velasquez, C., & McMullan, J. T. (2012). Cardiac arrest survival is rare without prehospital return of spontaneous circulation. *Prehospital Emergency Care*, *16*(4), 451-455.
- I.R. Drennan, S. Lin, D.E. Sidalak, et al.Survival rates in out-of-hospital cardiac arrest patients transported without prehospital return of spontaneous circulation: an observational cohort study Resuscitation, 85 (2014), pp. 1488-1493

Proč volat ECPR, funguje to vůbec ?

ECPR – ARREST trial

Advanced reperfusion strategies for patients with out-of-hospital cardiac arrest and refractory ventricular fibrillation (ARREST): a phase 2, single centre, open-label, randomised controlled trial

Demetris Yo… alra,
Marinos Kos… heide



Metoda v užším slova smyslu funguje !

(avoided transport and system issues)

3) highly experienced single center study

Yannopoulos, D., Bartos, J., Raveendran, G., Walser, E., Connett, J., Murray, T. A., ... & Aufderheide, T. P. (2020). Advanced reperfusion strategies for patients with out-of-hospital cardiac arrest and refractory ventricular fibrillation (ARREST): a phase 2, single centre, open-label, randomised controlled trial. *The Lancet*, *396*(10265), 1807-1816.

Není to jen o ECMO…
Prague OHCA trial design

Randomization

Inclusion criteria	Exclusion criteria
Age ≥18 and ≤ 65 years	OHCA of presumed non-cardiac cause
Witnessed OHCA of presumed cardiac cause	Unwitnessed collapse
Minimum of 5 minutes of ACLS performed by emergency medical service team without sustained ROSC	Suspected or confirmed pregnancy
Unconsciousness[1]	ROSC within 5 minutes of ACLS performed by EMS team
ECLS team and ICU bed capacity in cardiac center available	Conscious patient

Invasive arm

Intraarrest transport

NO ROSC

ROSC

ECPR

OHCA CENTER

ROSC

Pronounced dead

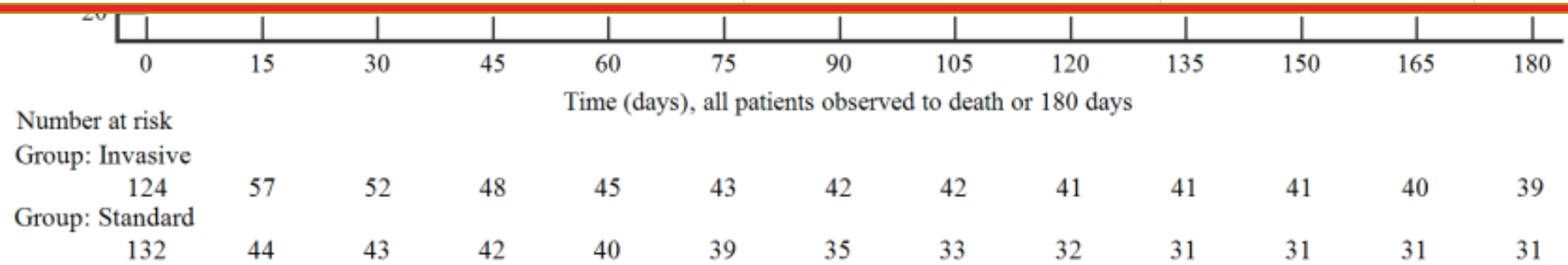
Standard arm

ACLS on site

Je ECPR systém lepší než konvenční systém?

1) limited sample size
2) underpowered for primary outcome
3) cross-overs and protocol deviations
4) highly experienced single center study

Factor	atio	95% CI	*P* value
Sex (female)			0.55
Age (per year)			**0.008**
Initial rhythm (PEA/Asystole)			**< 0.001**
Prehospital ROSC (yes)			**< 0.001**
Collapse to EMS arrival (per minute)			0.22
CPR time (per minute)	1.01	1.01–1.02	**< 0.001**
Place of cardiac arrest (public)	1.01	0.72–1.42	0.95
Successful PCI (yes)	0.77	0.52–1.12	0.18
ECPR (yes)	0.21	0.14–0.31	**< 0.001**



Belohlavek, J., Smalcova, J., Rob, D., Franek, O., Smid, O., Pokorna, M., ... & Prague OHCA Study Group. (2022). *JAMA*, *327*(8), 737-747.
Rob, D., Smalcova, J., Smid, O., Kral, A., Kovarnik, T., Zemanek, D., ... & Belohlavek, J. (2022). Critical Care, 26(1), 1-9.
Rob, D., Komárek, A., Šmalcová, J., & Bělohlávek, J. (2023). Chest.

Intraarrest transport, extracorporeal cardiopulmonary resuscitation, and early invasive management in refractory out-of-hospital cardiac arrest: an individual patient data pooled analysis of two randomised trials

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eClinicalMedicine 2023;59: 101988
Published Online xxx
https://doi.org/10.1016/j.eclinm.2023.101988

Summary

Background Refractory out-of-hospital cardiac arrest (OHCA) treated with standard advanced cardiac life support (ACLS) has poor outcomes. Transport to hospital followed by in-hospital extracorporeal cardiopulmonary resuscitation (ECPR) initiation may improve outcomes. We performed a pooled individual patient data analysis of two randomised controlled trials evaluating ECPR based approach in OHCA.

Pooled ARREST and Prague OHCA analysis
Survival with CPC 1 or 2 at 180 days

Panel A. Intention to treat analysis in the whole population of both trials.

Outcomes	Invasive (N = 139)	Standard (N = 147)	Absolute difference (CI), %	P value
Primary outcome				
Survival with minimal or no neurologic impairment at 180 days	45 (32·4 %)	29 (19·7 %)	12·7 (2·5-22·6)	**0·015**
Secondary outcomes				
Survival with minimal or no neurologic impairment at 30 days	44 (31·7 %)	24 (16·3 %)	15·4 (5·5-25)	**0·003**
Cardiac recovery at 30 days	60 (43·2 %)	46 (31·3 %)	11·9 (0·7-22·7)	0·05

Panel B. Intention to treat analysis in patients presenting with shockable rhythm.

Outcomes	Invasive (N = 87)	Standard (N = 99)	Absolute difference (CI), %	P value
Primary outcome				
Survival with minimal or no neurologic impairment at 180 days	41 (47·1)	28 (28·3)	18·8 (7·6-29·4)	**0·01**
Secondary outcomes				
Survival with minimal or no neurologic impairment at 30 days	40 (46)	24 (24·2)	21·8 (10·8-32·2)	**0·002**
Cardiac recovery at 30 days	49 (56·3)	42 (42·4)	13·9 (2·3-25·0)	0·08

NNT = 8

NNT = 5!!!

Belohlavek, J., Yannopoulos, D., Smalcova, J., Rob, D., Bartos, J., Huptych, M., ... & Aufderheide, T. P. (2023). Lancet - EClinicalMedicine, 59.

Mohou být výsledky zobecněny?

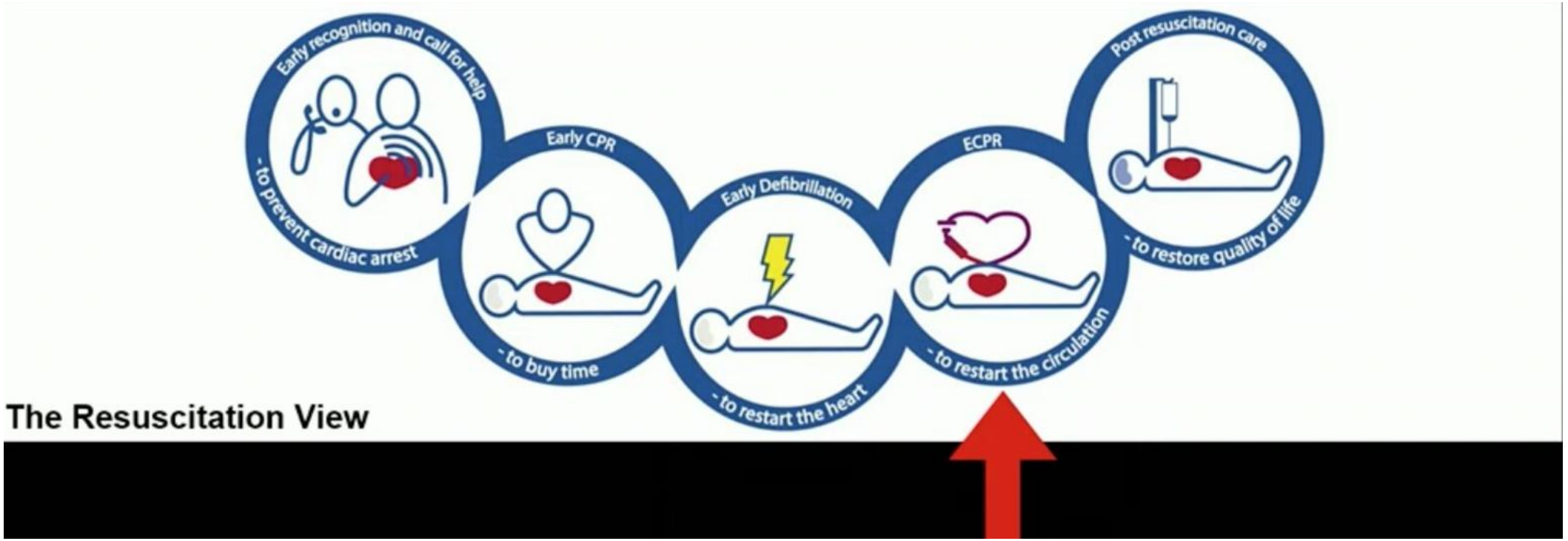
1) absence of EMS and hospital protocols and ECPR experience
2) prolonged interval from cardiac arrest to ECPR
3) different time point of randomization
4) unplanned post-randomization exclusions
5) low volume centers, low recruitment rate
6) limited sample size (46 ECPR)
7) many protocol deviations
8) early decannulation and withdrawal of care
9) low rate of CAG and PCI

Table 4. Survival with

Outcome		(N=63)†	Ratio (95% CI)	P Value	Risk Ratio (95% CI)
Primary outcome: 30 neurologic ou		0/62 (16)‡	1.4 (0.5–3.5)	0.52	1.05 (0.97–1.13)
Secondary outcomes					
3-month survival outcome					3.8)
6-month survival outcome		10/63 (16)	1.3 (0.5–3.3)		

Co je ECPR v širším slova smyslu

= komplexní systém s propracovanou logistikou a léčbou



ECPR systemic approach (key steps) overview

Step 1 – System design and quality	High rates of bystander CPR, cooperation between EMS and cardiac arrest center, ECPR model adjusted to the location and minimize time delays
Step 2 – Patient selection	Initial shockable rhythm, witnessed arrest, age ≤ 70 years, duration of no-flow and low-flow time
Step 3 - Transport	Timely decision, ensure high-quality CPR during transport, correct mechanical compression device use
Step 4 – Patient admission	Direct transport to the place of ECMO insertion without intra-hospital delay, rapid eligibility criteria re-assessment
Step 5 – ECMO cannulation	Percutaneous insertion with ultrasound and fluoroscopic guidance, Routine distal perfusion cannulation, Small team of highly experienced operators providing 24/7 service
Step 6 – initial diagnostic and therapeutic procedures	Immediate CAG in the absence of evident non-cardiac cause, Immediate PCI for culprit lesions only, Active temperature management
Step 7 – Intensive care	Centralized ECMO unit with experienced team of intensivists, Protocols for anticoagulation, ECMO, neuromonitoring
Step 8 – Hospital discharge and follow-up	Intensive rehabilitation and nutrition, ensure proper follow-up of survivors after hospital discharge

ECPR funguje, pokud je dobře nastaven systém

Proč je systém tak důležitý?

Grunau, B., Reynolds, J., Scheuermeyer, F., Stenstom, R., Stub, D., Pennington, S., ... & Christenson, J. (2016). Prehospital Emergency Care, 20(5), 615-622.
Hsu, C. H., Meurer, W. J., Domeier, R., Fowler, J., Whitmore, S. P., Bassin, B. S., ... & Neumar, R. W. (2021). Extracorporeal cardiopulmonary resuscitation for refractory out-of-hospital cardiac arrest (EROCA): results of a randomized feasibility trial of expedited out-of-hospital transport. Annals of emergency medicine, 78(1), 92-101.

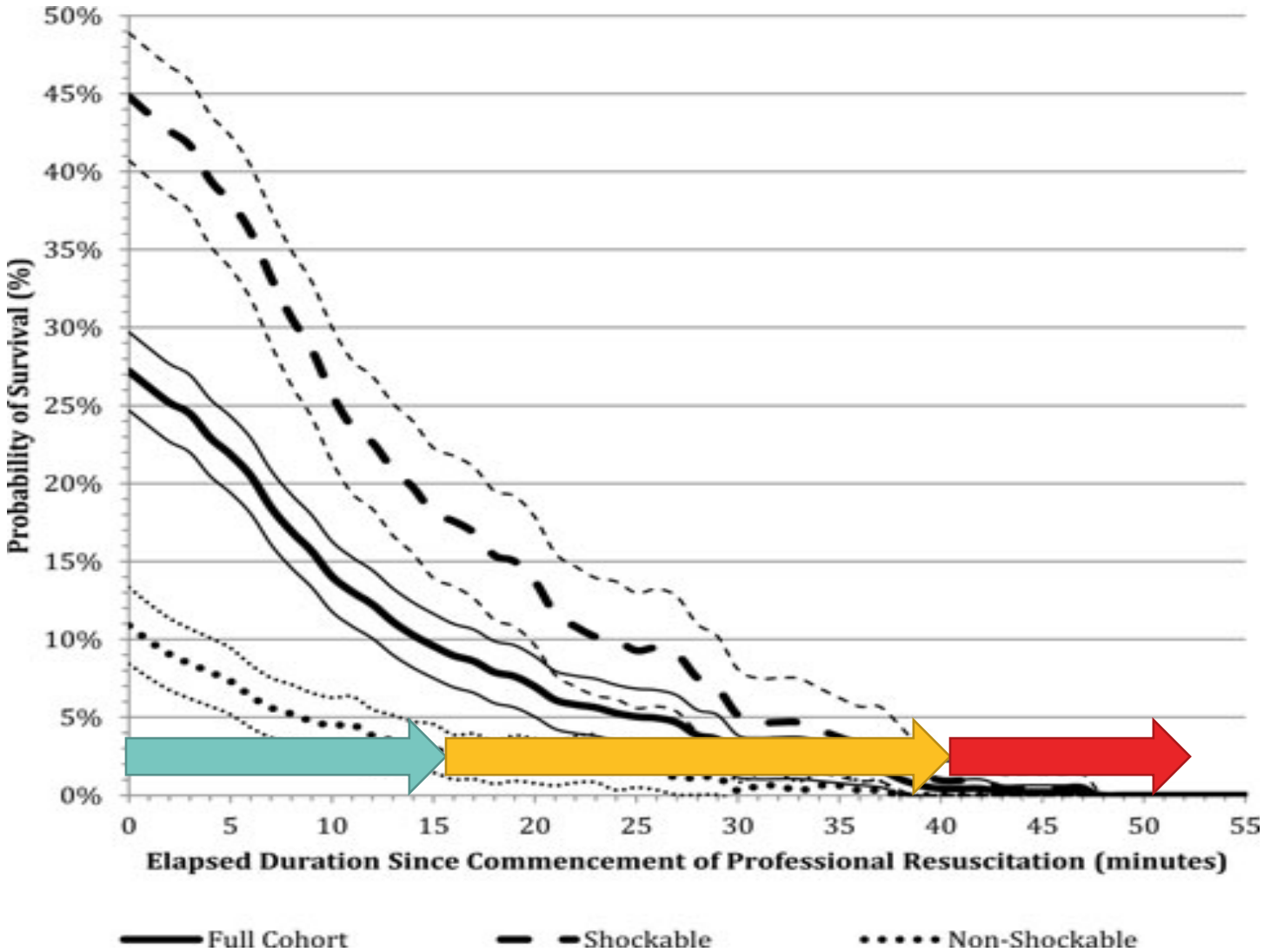
Kdy volat ECPR tým ?

- **První avízo ECPR týmu ihned** jakmile pacient splňuje kritéria pro ECPR
- Otevřená otázka **času zahájení transportu pacienta, času kanylace**
  - záleží na místě zástavy (IHCA, OHCA)
  - záleží na strategii ECPR (prehospital, in-hospital kanylace)
  - záleží na tom jaký je vstupní rytmus?
- **8 to 24** minutes of professional on-scene resuscitation, with **16 minutes** balancing the risks and benefits of early and later transport.

Relationship between Time-to-ROSC and Survival in Out-of-hospital Cardiac Arrest ECPR Candidates: When is the Best Time to Consider Transport to Hospital?

Brian Grunau, Joshua Reynolds, Frank Scheuermeyer, Robert Stenstom, Dion Stub, Sarah Pennington,

Čas.....proč volat včas



Pro jakého pacienta volat ECPR a koho napojit ?

SELEKCE PACIENTA
Věk ≤ **70 let**
Vstupní defibrilovatelný rytmus (PEA ve výjimečných případech)
Spatřená zástava
Laická resuscitace
VOLEJTE !
Minimálně ≥ 10 min ACLS bez ROSC a minimálně **3 defibrilace**

Závěr

- ECPR funguje v expertních centrech pro **selektované** pacienty s refrakterní srdeční zástavou (IHCA i OHCA).
- ECPR je komplexní, logisticky, personálně a časově náročná metoda.
- Mnoho otázek (kdy, jak a komu) zůstává otevřeno, velký potenciál prehospital kanylace a nových technologií.