

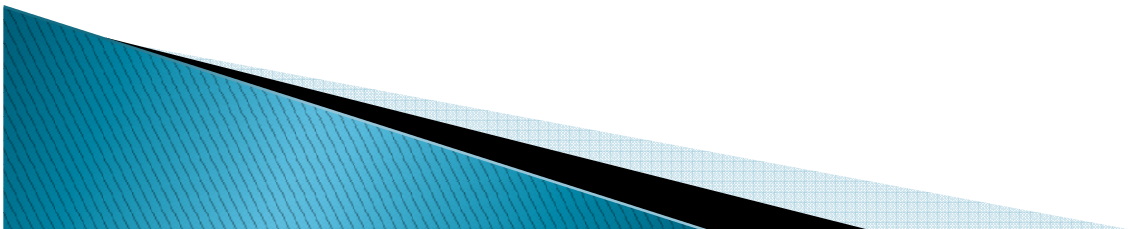
# Clinical Aspects of Rescue CPS



Carin van Doorn MD FRCS(CTh)  
Cardiothoracic Surgeon  
Aarhus University Hospital

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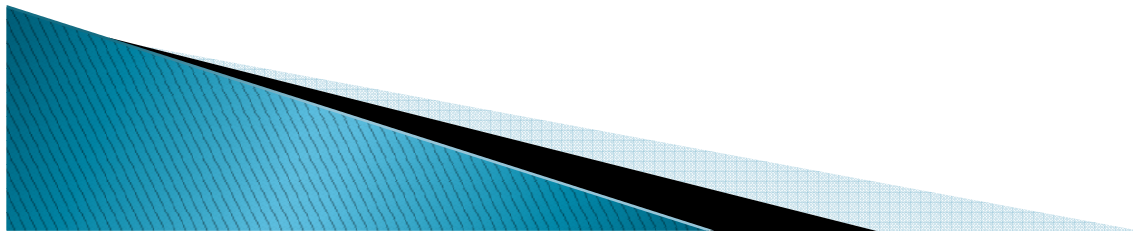
- ▶ Definition of Rescue CPS
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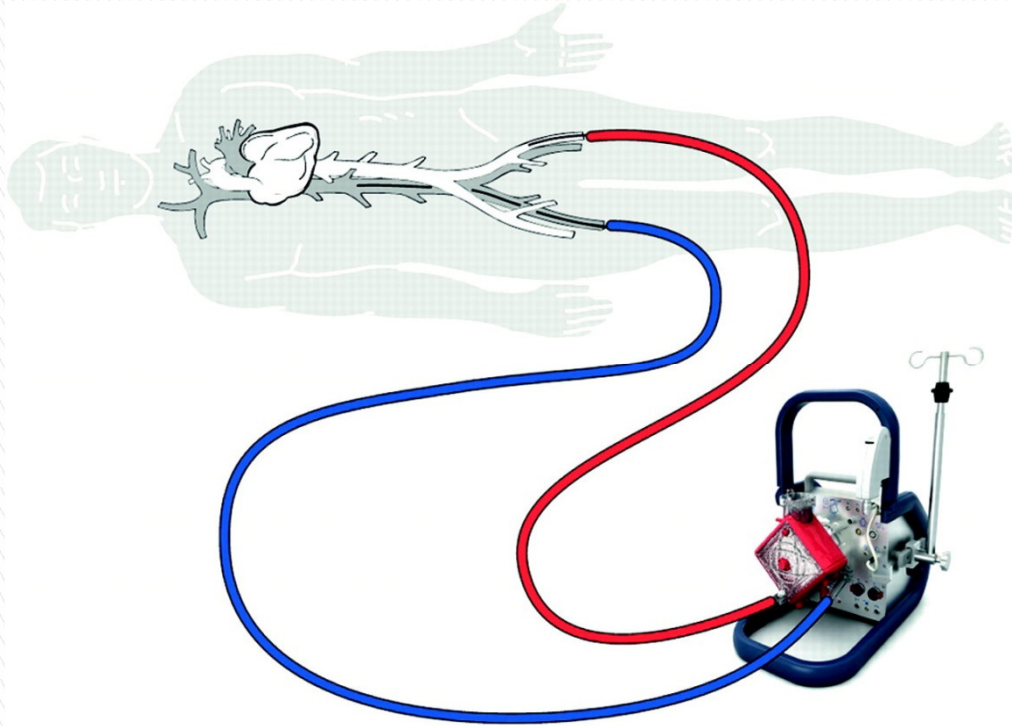
# Definition of Rescue CPS

‘Sophisticated technique for circulating blood outside the body with or without extracorporeal oxygenation, with the goal of supporting the bodies circulation during refractory cardiac arrest’

- ▶ ECMO – Extracorporeal membrane oxygenation
- ▶ Cardiopulmonary bypass
- ▶ Extracorporeal Cardiopulmonary Resuscitation (Extracorporeal CPR, ECPR)
- ▶ Extra Corporeal Life Support (ECLS)



# Rescue CPS system

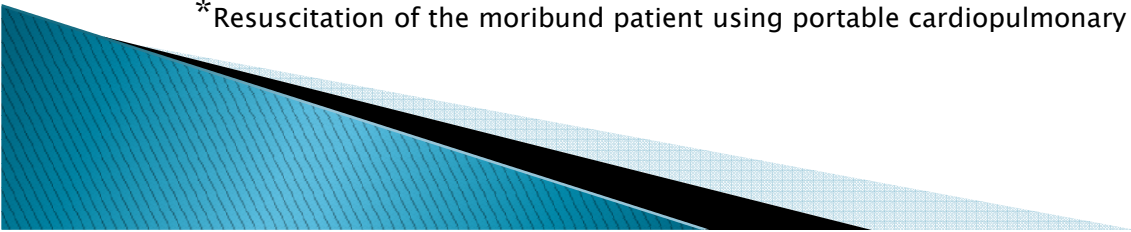


- ▶ Mechanical blood pump
- ▶ Portable
- ▶ With/without oxygenator
- ▶ Peripheral cannulation

# Clinical development of CPS

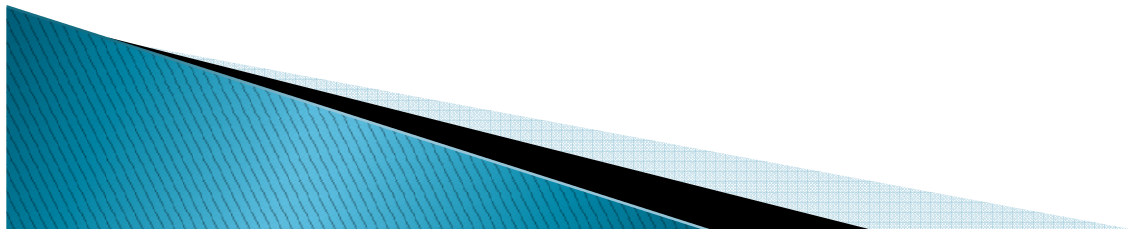
- ▶ 1953 J Gibbons. First successful open heart operation using cardiopulmonary bypass machine
- ▶ 1970s Explosive development of cardiac surgery
- ▶ 1976 KL Mattox. Report of first series of CPS for cardiac resuscitation using a portable battery-powered ECMO machine:  
19 pts placed on CPS via fem art and vein cannulation within 15 min of cardiac arrest – 16 survived 30 days, 15 long-term survivors\*.
- ▶ For many years, use of CPS outside the cardiac operating room remained restricted to particular subsets of patients such as post-cardiotomy support, accidental hypothermia and massive drug overdose.

\*Resuscitation of the moribund patient using portable cardiopulmonary bypass Ann Thorac Surg 1976 5 436-4)



# Further advances in Rescue CPS

- ▶ Development in cardiopulmonary bypass technology
  - miniaturized extracorporeal devices
  - biocompatibility
  - cannulae and cannulation techniques
  - monitoring
- ▶ Improved early resuscitation for cardiac arrest
- ▶ Emerging clinical reports that *early* application of ECMO by *highly specialised* teams may improve prognosis of *prolonged* cardiac arrest of both in *in-hospital* and *out-hospital* setting.



# Outcomes in recent published literature

Author	Year	No pts	Weaned from CPS	In hosp Surv	30 day Surv
Raither	1989	29	20.6%	20.6%	
Reedy	1990	38	63.1%	24%	
Younger	1994	25	36%		
Chen	2003	57	66.7%	31.6%	28%
Schwarz	2003	46	61%	28%	
Masseti	2005	40	15%, 23% to VAD	20%	20%
Chen	2006	36	67%	33%	
Megarbane	2007	17	25%	25%	18%
Chen	2008	135	58.5%	34.1%	
Chen	2008	59	49%	28%	
Thiagarajan	2009	297		27%	
Nagao	2010	171		19%	
Kagawa	2010	77		26%	
Jaski	2010	150	40%	26%	
Liu	2011	11	63.7%	36.4%	
Megarbane	2011	66		6%	
Le guen	2011	51		12%	2%
Morimura	2011	139	58.4%		
Shin	2011	85		34%	28%
Avalli	2012	42	55.1%	40.4%	
Kim	2012	27	81.5%	59.3%	32.7%
Sakamoto	2012	98	55.1%	29%	24%
Kagawa	2012	86	50%		29%

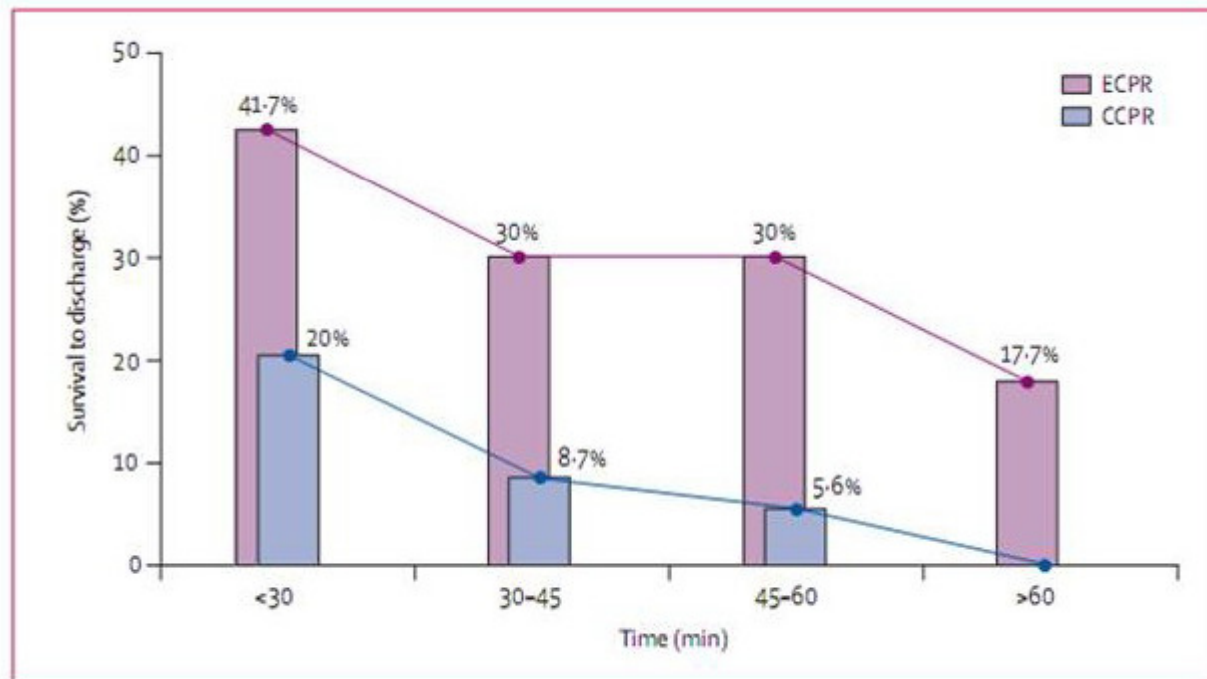
- Increasing interest in the Rescue CPS
- Case studies and small series
- Very mixed populations
- Various study designs
- Widely varying results

No controlled randomized trials

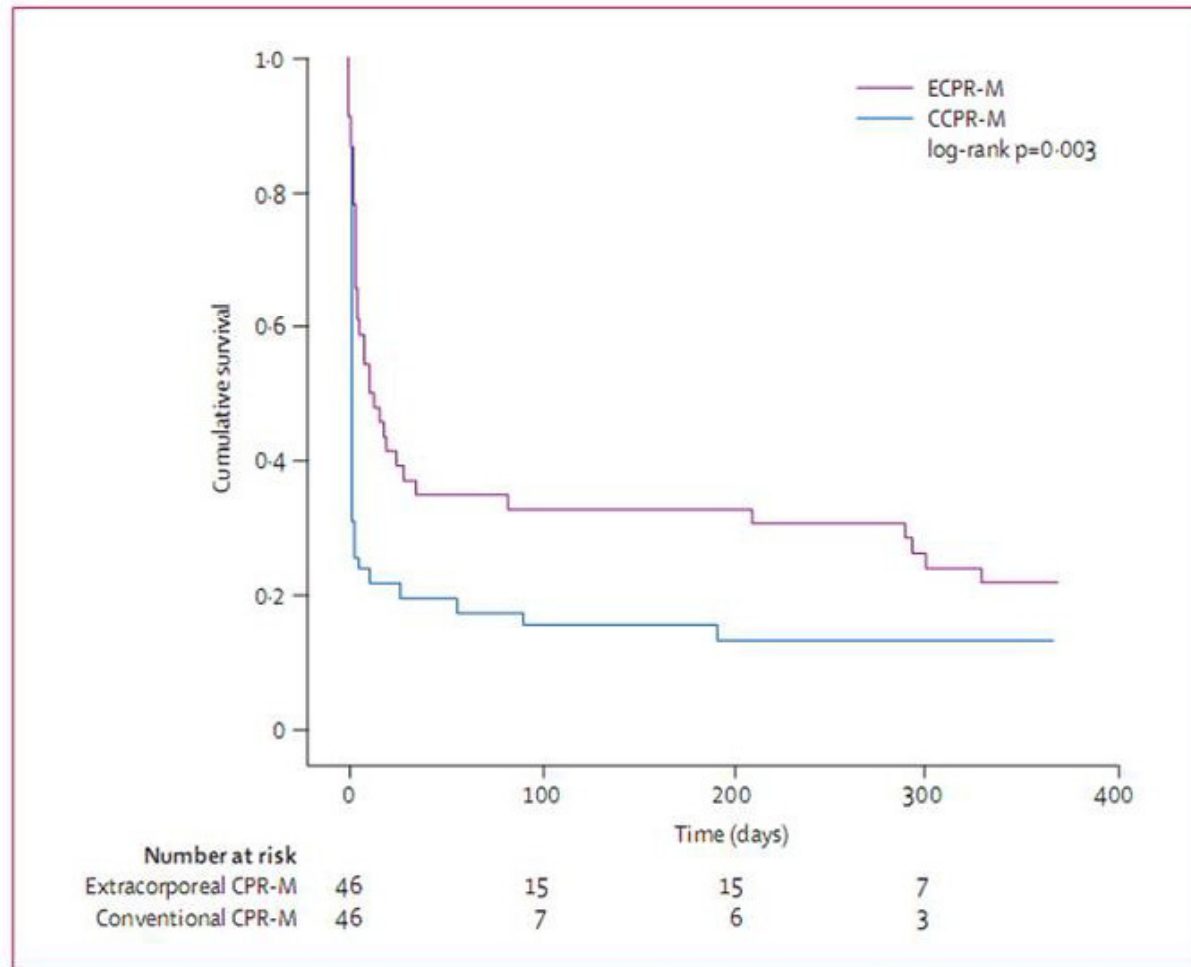
# Landmark studies: In Hospital Rescue CPS

- ▶ Chen et al.  
Cardiopulmonary resuscitation with assisted extracorporeal life-support versus conventional cardiopulmonary resuscitation in adults with in-hospital cardiac arrest: an observational study and propensity analysis.  
  
▶ Lancet 2008;372:554–61
- ▶ Study from Taiwan
- ▶ 3 yr prospective observational study
- ▶ Patients 18–75 yrs
- ▶ Witnessed in hospital arrest of cardiac origin
- ▶ CPR for more than 10 min
- ▶ 59 pts receiving Rescue CPS compared with pts receiving conventional CPR (propensity score matching)

- ▶ Relation between CPR duration and survival to discharge



- ▶ Kaplan–Meier plot of the survival curves in the Rescue CPR and conventional CPR groups at one year



# Landmark studies: Out of Hospital Rescue CPS

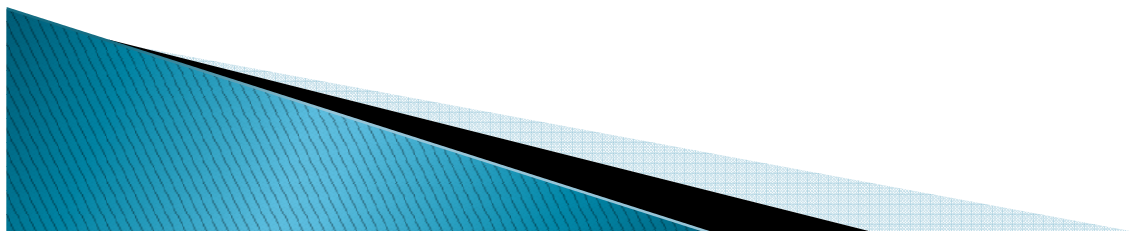
- ▶ Le Guen et al.
- ▶ Extracorporeal life support following out-of-hospital refractory cardiac arrest
- ▶ Critical Care 2011:15 R29
- ▶ Study from France
- ▶ Observational study
- ▶ 51 consecutive pts witnessed out of hospital cardiac arrest receiving automated chest compression
- ▶ Rescue CPS on hospital arrival by mobile cardiothoracic team

# Results

- ▶ Medium time from arrest to CPR 3 (1–7)min
- ▶ To Rescue CPS 120 (102–149) min
- ▶ Rescue CPS failed in 9 pts (18%)
- ▶ 2 Pts (4%) alive at day 28 with favourable neurological outcome
- ▶ Deaths related to multiorgan failure (47%), brain death (20%), refractory haemorrhagic shock (14%)
- ▶ 90% died within 48 hrs
- ▶ Significant correlation between blood lactate and delay of between arrest and onset of Rescue CPS, but not with arterial pH or serum K

# Further discussion of literature

- ▶ Selection of patients for consideration of Rescue CPS
- ▶ Predictors of outcome during Rescue CPS
- ▶ Importance of local organisation of health care
- ▶ Ethical dilemmas resulting from Rescue CPS



# Exclusion criteria used in studies

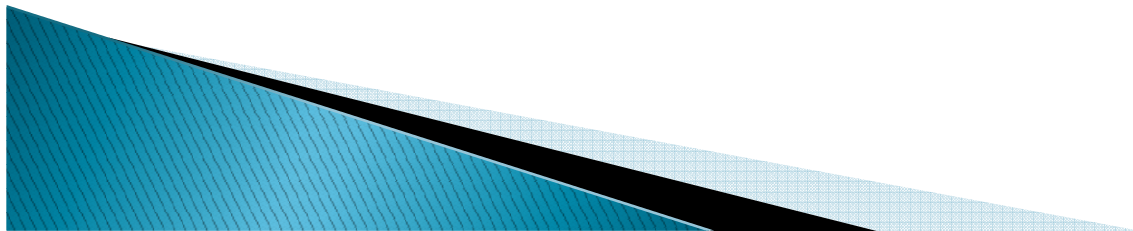
- ▶ Factors perceived to be risk factors based on previous clinical experience, but actually often not formally tested in studies
- ▶ Previous severe neurologic damage
- ▶ Current intracranial haemorrhage
- ▶ Terminal malignancy
- ▶ Trauma with uncontrolled bleeding
- ▶ Sepsis leading to cardiac arrest
- ▶ Irreversible organ failure (hepatic failure, late ARDS)
- ▶ Aortic dissection
- ▶ Patient had signed 'do not resuscitate' form

# Possible predictive factors for outcome

- ▶ Favourable outcome
- ▶ greater lactate clearance
- ▶ access to emergency percutaneous revascularisation
- ▶ Poor outcome
- ▶ SpvO<sub>2</sub> < 8%
- ▶ Lactate > 21 mmol/l
- ▶ fibrinogen less 0.8
- ▶ PTT less 11%
- ▶ Renal dysfunction after Rescue CPS
- ▶ Longer duration of conventional CPR

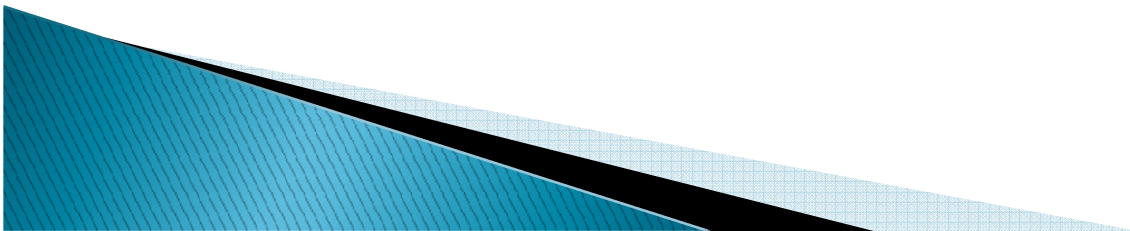
# Importance of infrastructure

- ▶ Quality of pre-hospital CPR
- ▶ In hospital 24 hr presence of highly trained anaesthetic, surgical, imaging and interventional team
- ▶ Quality of Intensive care facilities (such as secondary neuroprotective skills)



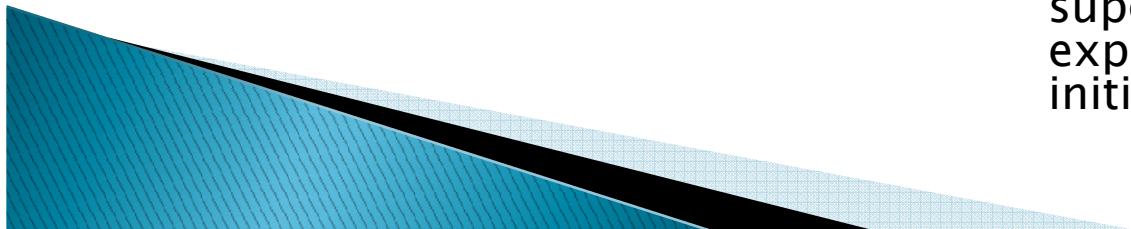
# Ethical challenges

- ▶ The decision to start and stop resuscitation efforts requires clinical judgement and respect for human dignity  
Little data and little time is available to guide this decision
- ▶ The application of Rescue CPR techniques for preservation of donor organs



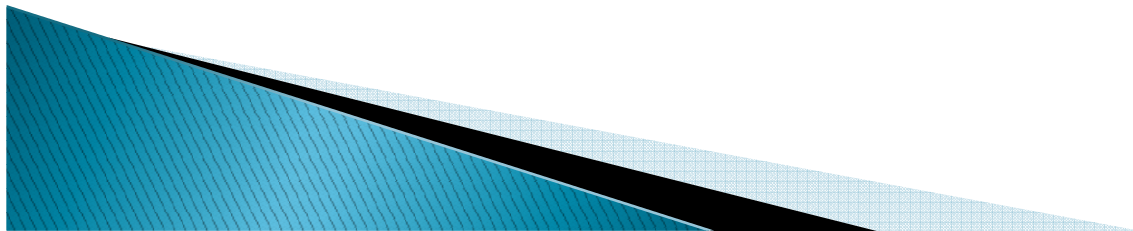
# Place of rescue CPS in current resuscitation guidelines

- ▶ American Heart Association 2010
- ▶ Insufficient evidence to recommend the routine use of ECPR for patients in cardiac arrest. However, in setting where ECPR is readily available, it may be considered when the time without blood flow is brief and the condition leading to the cardiac arrest reversible (e.g. hypothermia, drug intoxication, revascularisation)  
  
Class IIb [benefit equal or greater than risk, additional studies or registry data would be helpful. Procedure/treatment may be considered] LOE C [very limited populations evaluated, studies without a control group]
- ▶ European Resuscitation Council Guidelines 2010
- ▶ No clinical adjunct currently recommended for routine use in stead of manual CPR, however some are now routinely used by highly trained groups in in or out hospital situations.
- ▶ Role of mechanical devices requires further evaluation. Rescuers should be well trained and effect of adjunct is closely monitored and that adjunct does not adversely affect survival
- ▶ Extracorporeal life support should be considered for children with cardiac arrest refractory to conventional CPR, if the arrest occurs in a highly supervised environment and available expertise and equipment to rapidly initiate ECLS



# Conclusions

- ▶ Rescue CPR can improve outcome of refractory cardiac arrest under certain circumstances
- ▶ The application of this technique requires well trained personnel, equipment and infrastructure
- ▶ Improvement in Rescue CPR systems should facilitate deployment and cannulation
- ▶ Patient selection and clinical situations for application of rescue CPR require more structured investigation



Thank you

