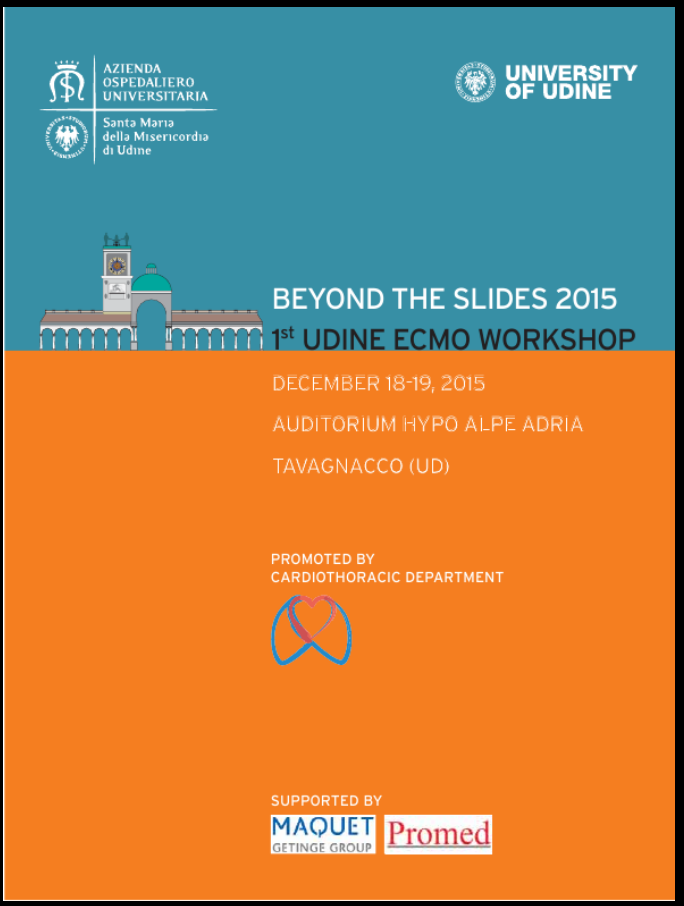
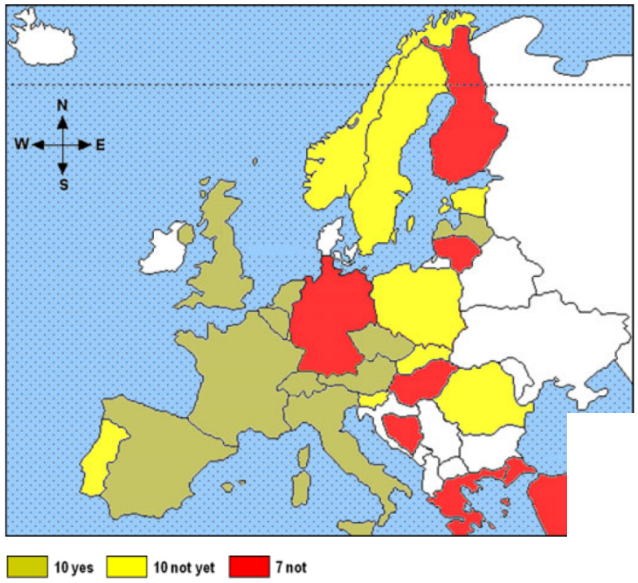
S.C. Anestesia e Rainimazione
IRCCS - Policlinico "S. Matteo"
Cattedra di Anestasia e
Rianimazione
Università degli Studi di Pavia



ECMO in Donation after Cardiac Death: Italian experience

Dr. M.Zanierato

Italian DCD program started in 2007



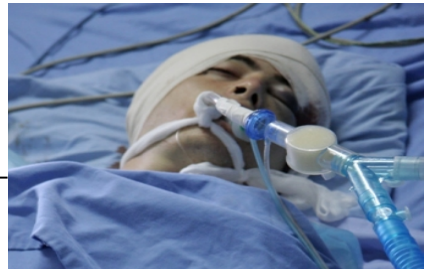
	No touch period (min)	Procurement protocol	Donation program	Allocation DCD organs
Austria	10	–	1 center	Local
Belgium	5	Super-rapid laparotomy and sternotomy with direct arterial cannulation	National	National
Czech Republic	10	DB	Centers	Special
France	5	ECMO, DB	Centers	Local
Italy	20	NECMO	National	Local
Latvia	15	DB	National	National
The Netherlands	5	Super-rapid laparotomy and sternotomy with direct arterial cannulation	National	National
Spain	5	ECMO, NECMO, DB	Centers	Local/special
Switzerland	10	–	Centers	Local
United Kingdom	5	Super-rapid laparotomy and sternotomy with direct arterial cannulation	National	Local

Transplant International © 2011 European Society for Organ Transplantation **24** (2011) 676–686

The possible scenarios

Category	Sub-category	Description	Type
Category I Uncontrolled Unwitnessed CA	**I A – In-hospital**	Sudden-unexpected-irreversible CA; no attempt of resuscitation by a medical team. WIT to be	**Uncontrolled**
Category II Uncontrolled Witnessed CA	**II A – In-hospital** / **II B – Out-of-hospital**	Sudden-unexpected-irreversible CA; unsuccessful resuscitation by a medical team. In- or out-of-hospital setting	**Uncontrolled**
circulatory death		Euthanasia Excluded	
Category III Controlled Awaiting circulatory death	---	Planned, expected CA; withdrawal of life-sustaining treatment; Euthanasia Excluded	**Controlled**
IV B - Death diagnosis during ECMO-ECLS	Death determination by circulatory (DCD) or neurologic (DBD) criteria		**Partially controlled**

ECLS Program



Out of hospital

No-flow <10 min

Good quality of CPR (autopulse)- FV/TV

Assesment of time from collapse to door

Time ≤ 60 min

In hospital

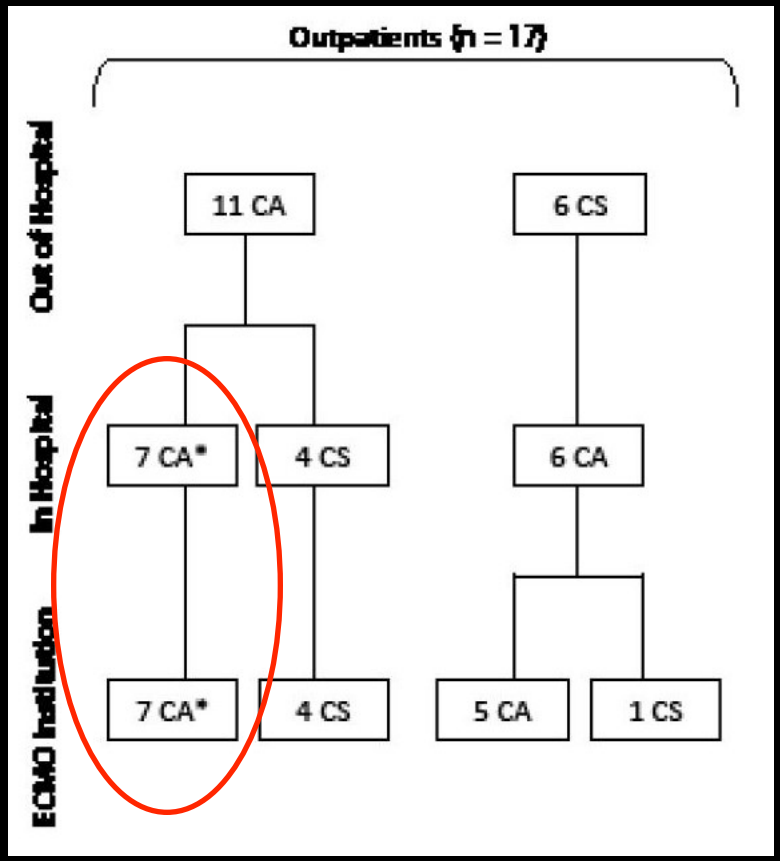
Assesment of end-tidal CO2

End-tidalCO2> 10 mmHg

Now-flow < 80 min

Indication for ECMO support

ECLS ineffective



Median time to CRP 7 min (6-8)
Median time to ECMO 93 min (74-107)

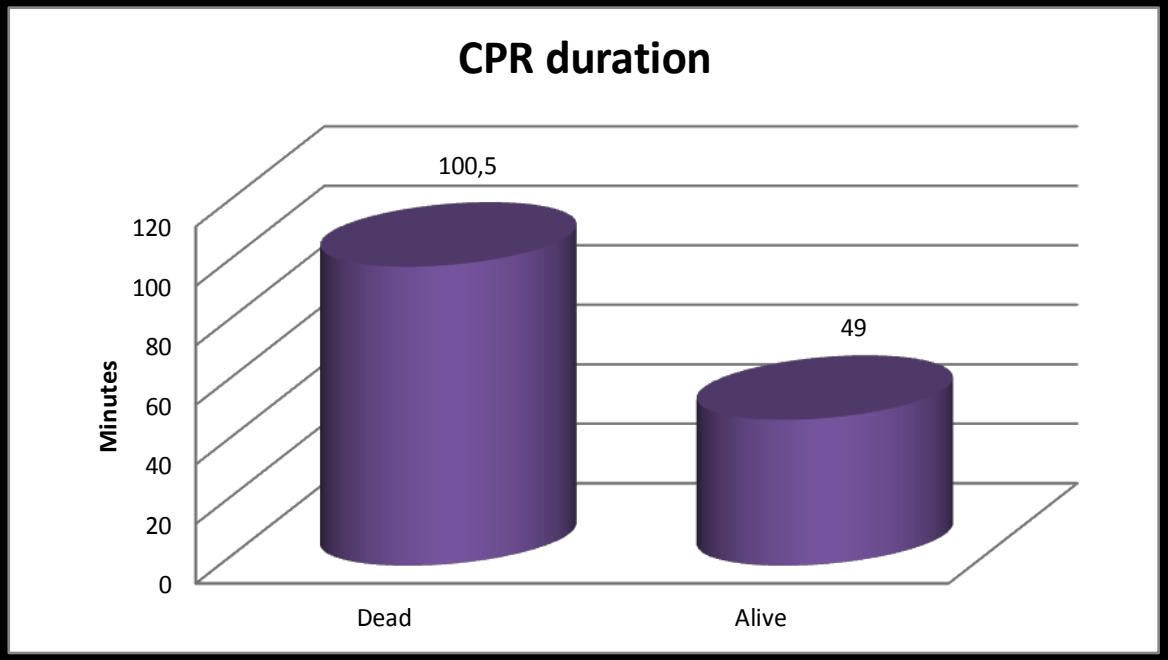
After a median of 20 hours (16-22) of ECMO all pts of this subgroup died:
in 3 pts BD
in 4 pts ECMO was withdrawn because ineffective

MINERVA ANESTESIOLOGICA

Vol. 79 - No. 4

Hospital survival and long term quality of life after emergency institution of venoarterial ECMO for refractory circulatory collapse

F. MOJOLI [1, 2], A. VENTI [3], C. PELLEGRINI [4, 5], G. M. DE FERRARI [6], M. FERLINI [6]
M. ZANIERATO [1], M. MAURELLI [7], G. A. IOTTI [3], A. M. D'ARMINI [4, 5], A. BRASCHI [1, 2]



P < 0.002

Significative correlation between CPR duration pre-ECLS and mortality (no flow/low flow)

Vol. 79 - No. 4

MINERVA ANESTESIOLOGICA

CRITERI CLINICI E RACCOMANDAZIONI PRATICHE INERENTI L'ACCERTAMENTO DI MORTE IN SOGGETTI SOTTOPOSTI AD ASSISTENZA CIRCOLATORIA EXTRACORPOREA

ECLS
ineffective

DCD donors
Cardiocirculatory
criteria

DBD donors
Neurological
criteria

DCD II

“ALBA” PROGRAM

Italian DCD II program

WITNESSED CARDIAC ARREST (CA)

<15’

BLS/ACLS

DIAGNOSIS OF IRREVERSIBLE CA

Mutidisciplinary team evaluation: No-flow <15 min, low- flow >60-80min, Asystolia , ET CO2 < 10 mmHg, no indication to ECMO support

ARRIVAL IN HOSPITAL

Check for exclusion criteria:

Age > 18< 65 yrs

Past medical history

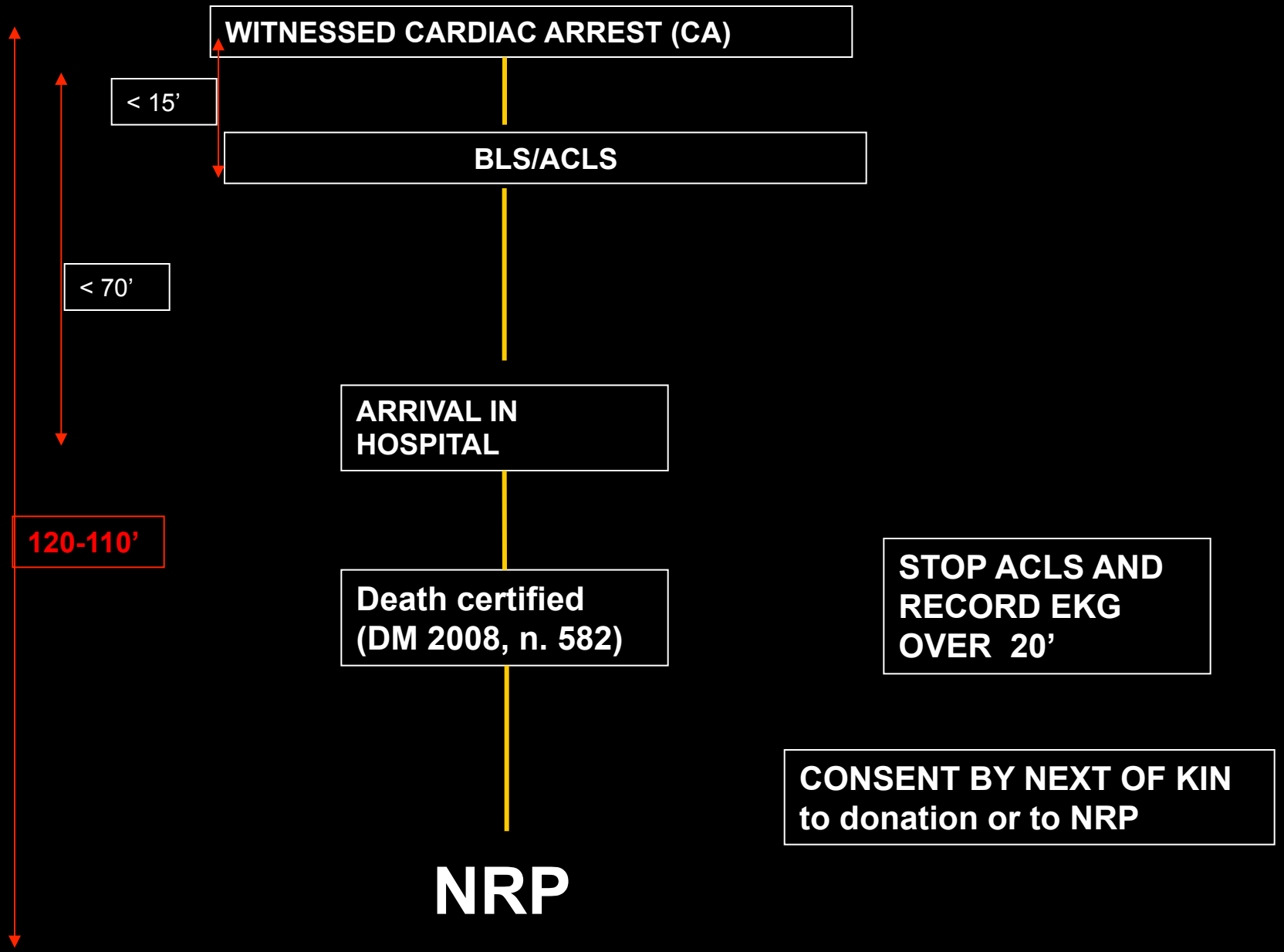
STOP ACLS AND RECORD EKG OVER 20’

Heparin bolus infusion

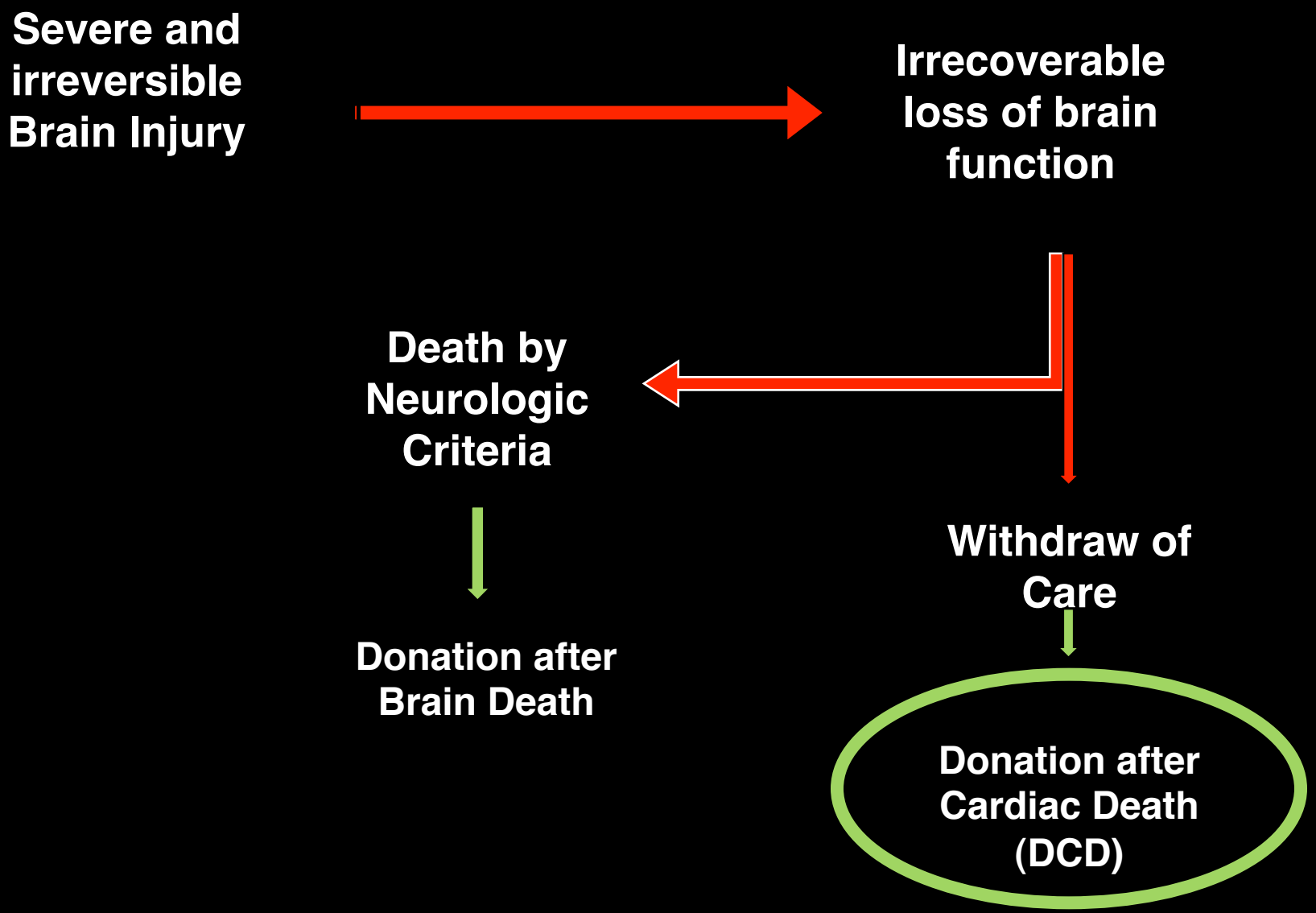
CONSENT BY NEXT OF KIN

Normothermic Regional Perfusion (NRP)

Italian DCD II program



DCD in ICU


Severe and irreversible Brain Injury
Irrecoverable loss of brain function
Death by Neurologic Criteria
Withdraw of Care
Donation after Brain Death
Donation after Cardiac Death (DCD)

Treatment Futility

LINEE GUIDA SIAARTI

MINERVA ANESTESIOL 2003;69:101-18

SIAARTI guidelines for admission to and discharge from Intensive Care Units and for the limitation of treatment in intensive care

GRUPPO DI STUDIO AD HOC DELLA COMMISSIONE DI BIOETICA DELLA SIAARTI

Prolonged WIT

…very variable period of ischemic damage due to cardiac standstill (no-flow) followed by cardiac resuscitation (low-flow) with a varied degree of effectiveness……**no-flow > 30 min** is associated to very poor graft survival…….

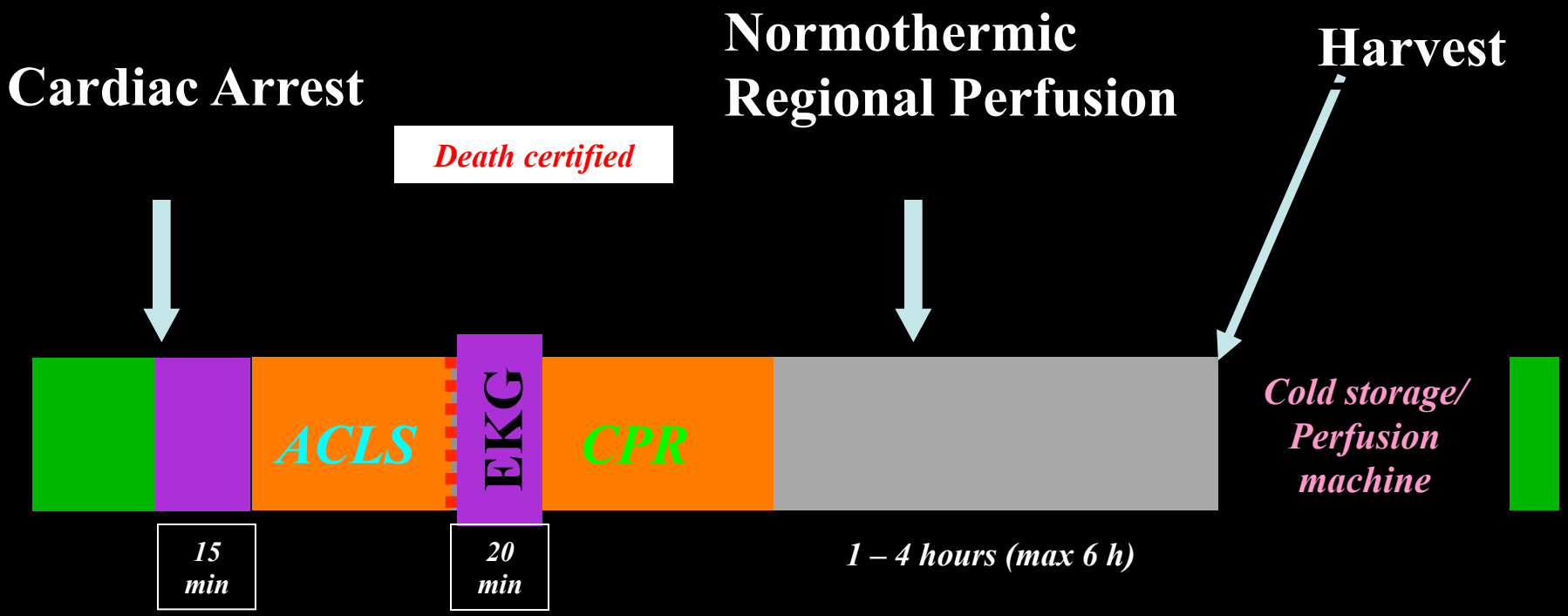
D Monbaliu, J Pirenne, D Talbot, J Hepatology 2012; 56: 474-485

Donation after cardiac death: is a "paradigm shift" feasible in Italy?

V. FANELLI [1], P. M. GERACI [2], L. MASCIA [1]

This time negatively affects donation after cardiac death because warm ischemic time (WIT) – the most important predictor of grafts' poor outcome – is prolonged. However, this time seems to be prudential to define the irreversibility of death and to respect the "dead donor rule", as established by the National Committee of Bioethics. National reference protocols regulating DCD practice are therefore a compelling issue. *(Minerva Anestesiol 2013;79:534-40)*

Time point uncontrolled DCD

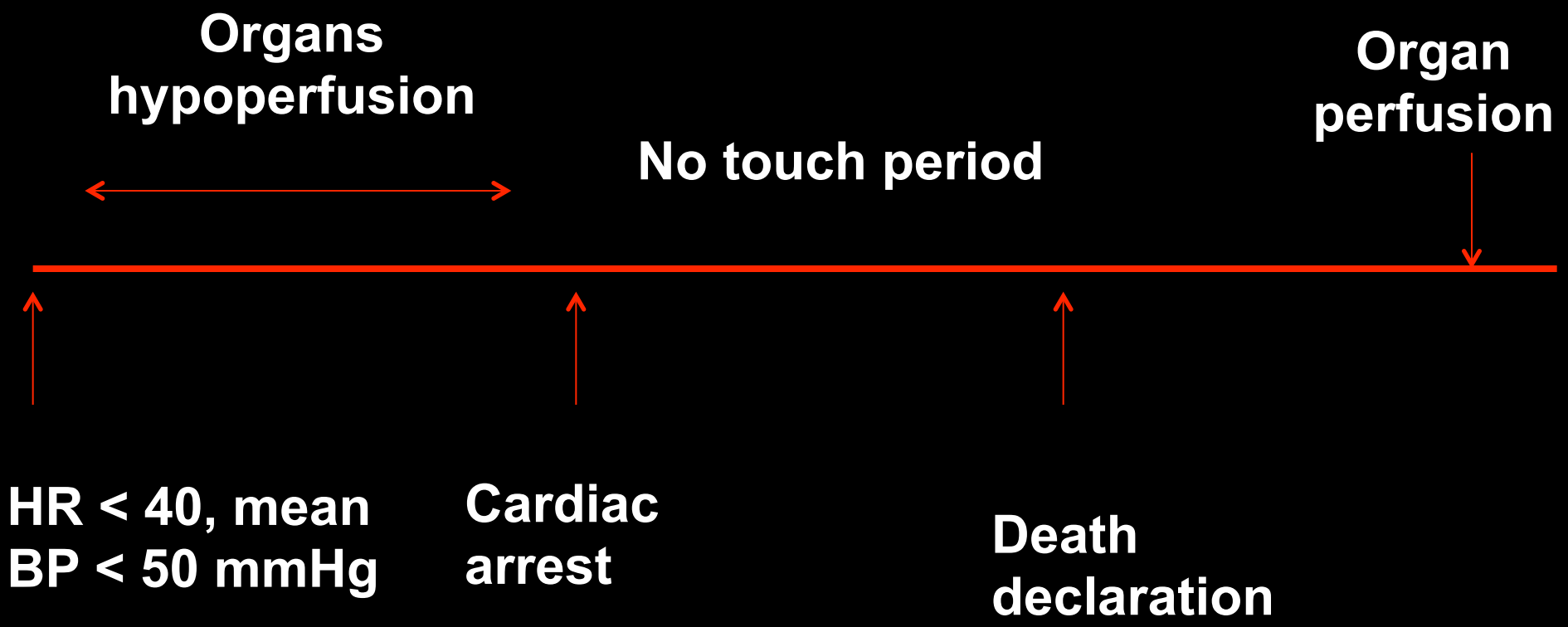


120 min

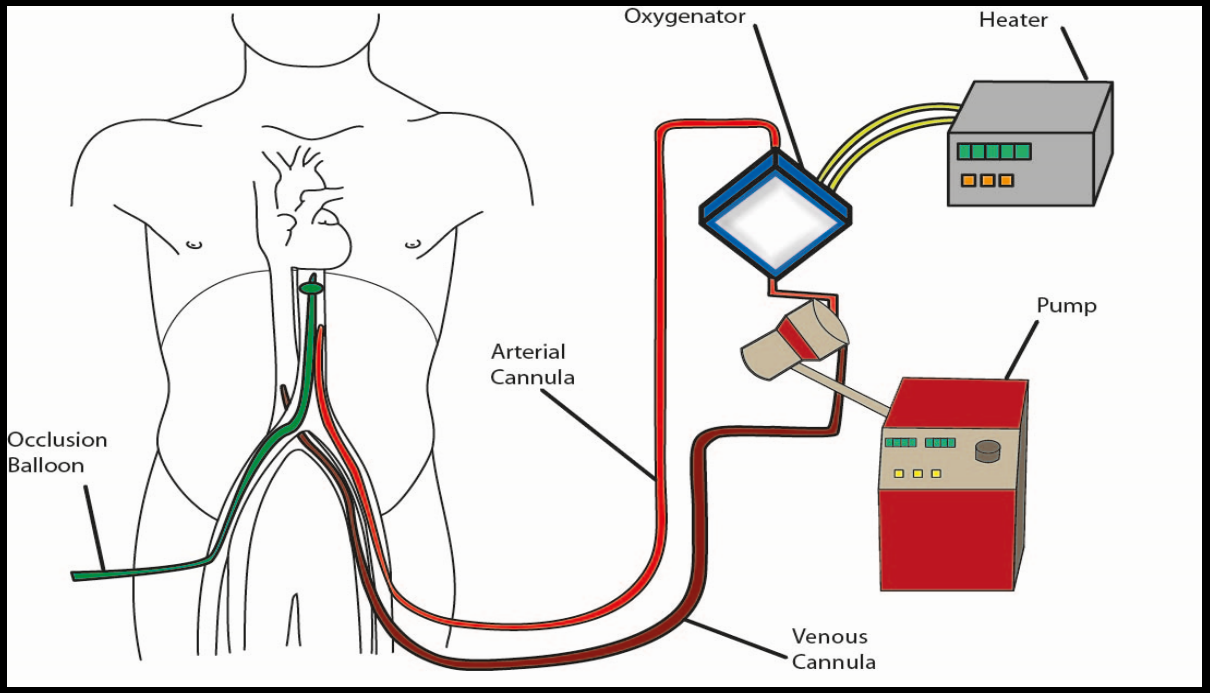
Warm ischemia time (WIT)

'Real' WIT (no flow)

Time point controlled DCD

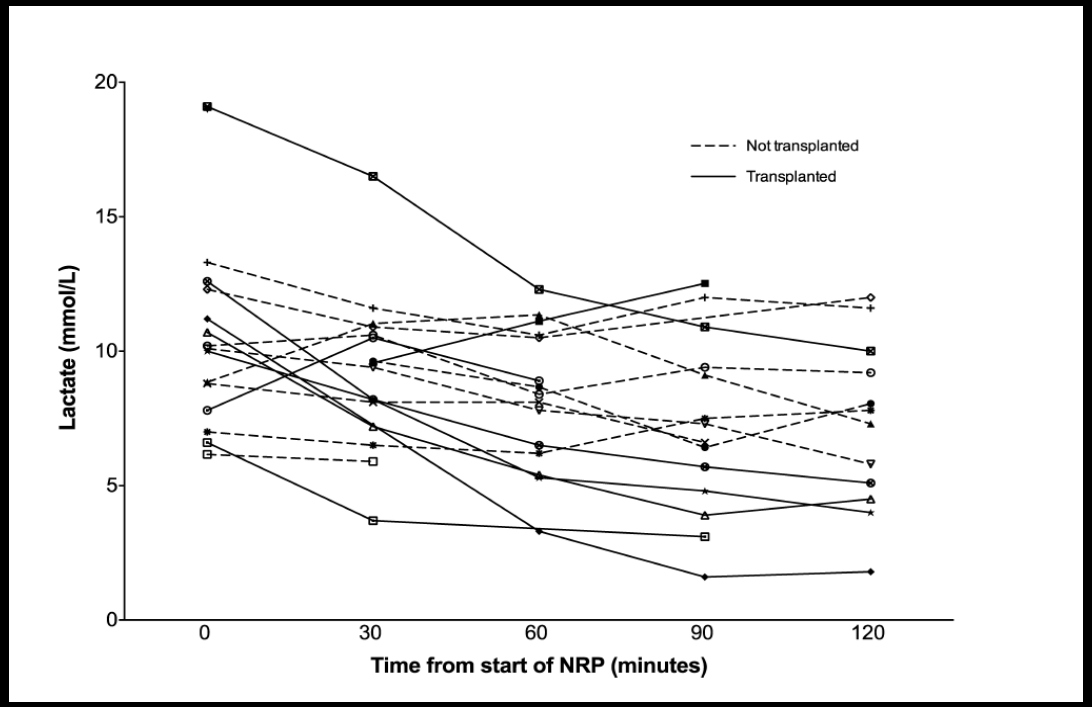


Normothermic Regional Perfusion (NRP)



Heparin bolus (300 UI/ kg) before no touch period
Femoral artery and vein cannulation
Fogarthy catheter inflated at the supraceliac aorta
Pump flow during nECMO : 1.7-3 l/min
nECMO time: 240-480 min

NRP could shift the warm ischemia time to an ischemic preconditioning

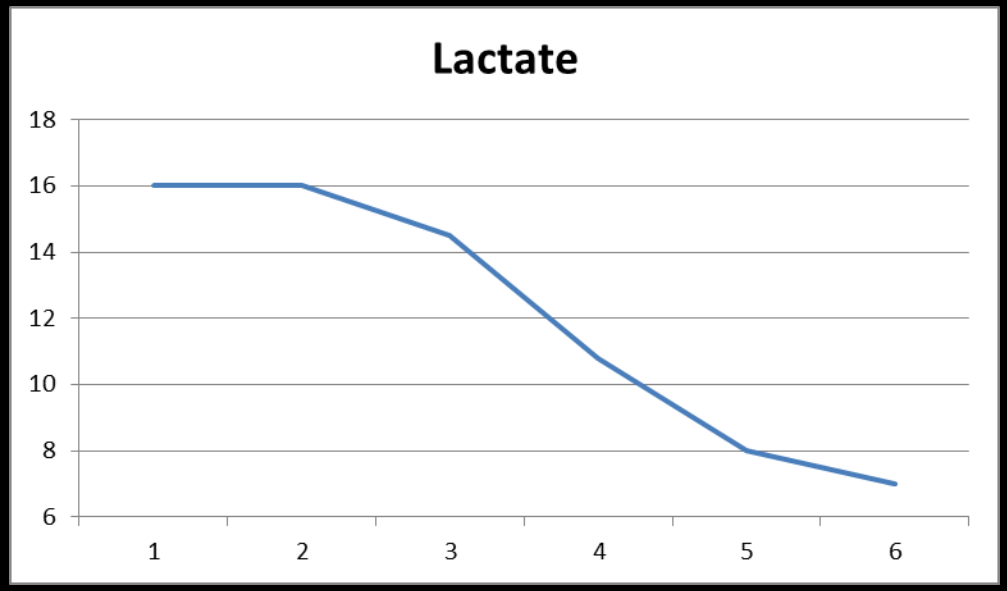


NRP reduces anaerobic metabolism during preservation period

A period of 2 hours of NRP could potentially reverse the warm ischemia time effects, by restoring the supply of oxygen to the tissues

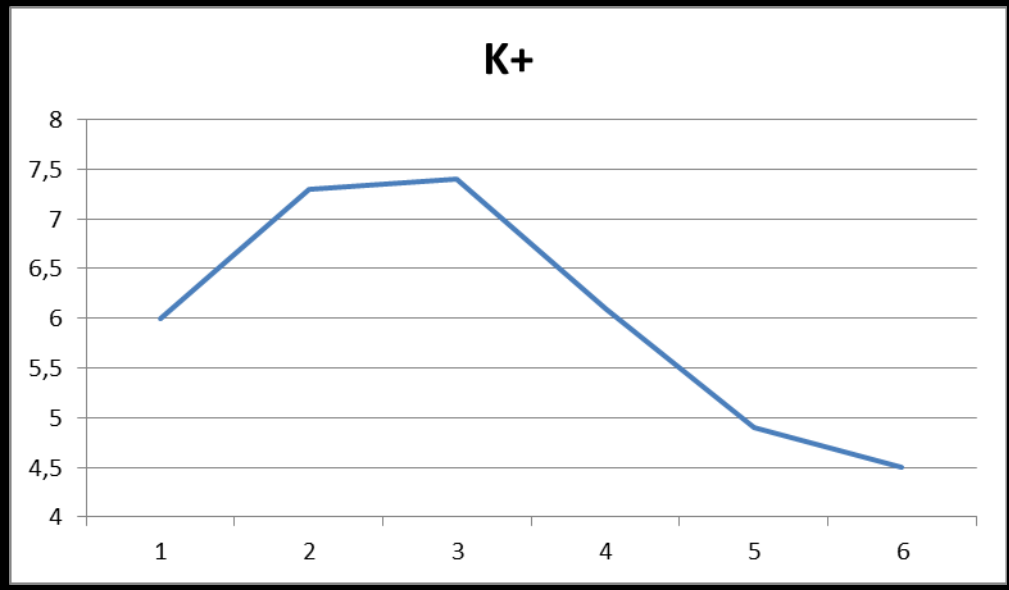
Oniscu et al

American Journal of Transplantation 2014; 14: 2846–2854



NRP for 6 hs offers the possibility of restoring metabolic process, repairing damaged cells and preventing irreversible damage

Abdominal organ function and homeostasis during NRP monitored every 60’ using blood gases (pH, PO2, PCO2, bicarbonate, base excess, lactate), and biochemistry (ALT, AST), urea, creatinine, potassium)



In the case of DCD II after livers procurement, evaluation in ex-situ normothermic perfusion machine (MP) is imperative

MP continues with the physiological aerobic metabolism, providing the liver with specific substrates in order to revert the riperfusion injury

MP provides an alternative means for assessing liver function and an opportunity for liver repair

Oniscu et al

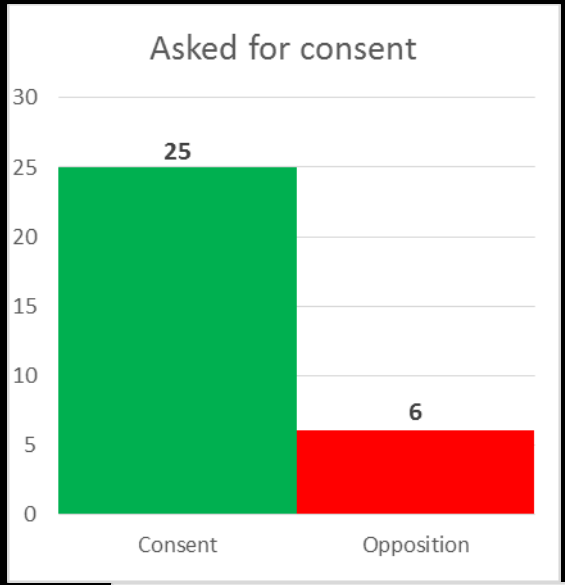
American Journal of Transplantation 2014; 14: 2846–2854

Results (sept 2007-nov 2015): 42 potential DCD

41 unreversible CA/
1 severe brain injury

39 Male/3 female

Mean age 50yrs (36-63)

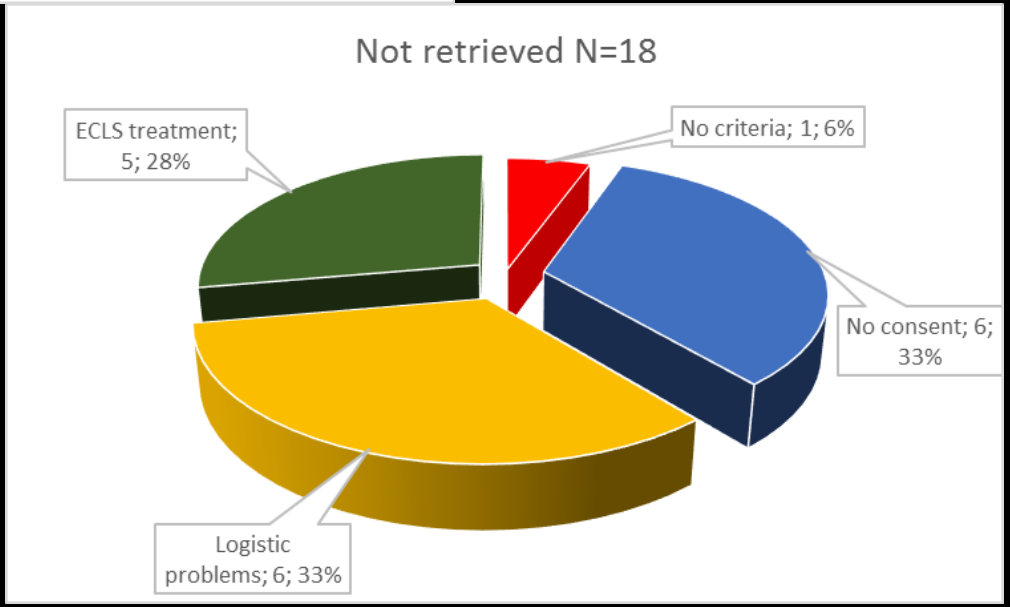


Mean no- flow 10,4 min

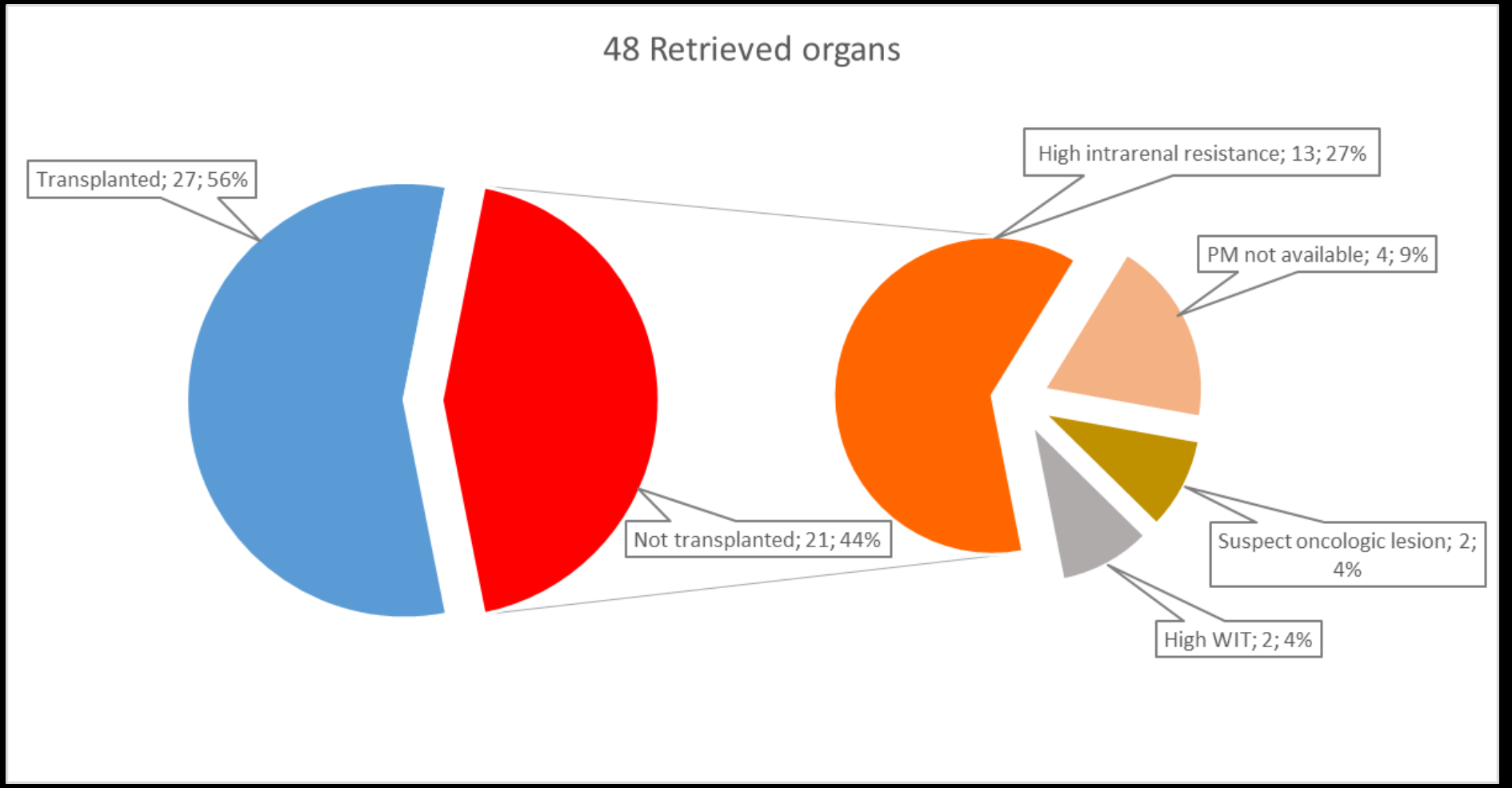
Mean low flow 72,8 min

Low-flow > 100 min 17 pts

24 effective DCD donors

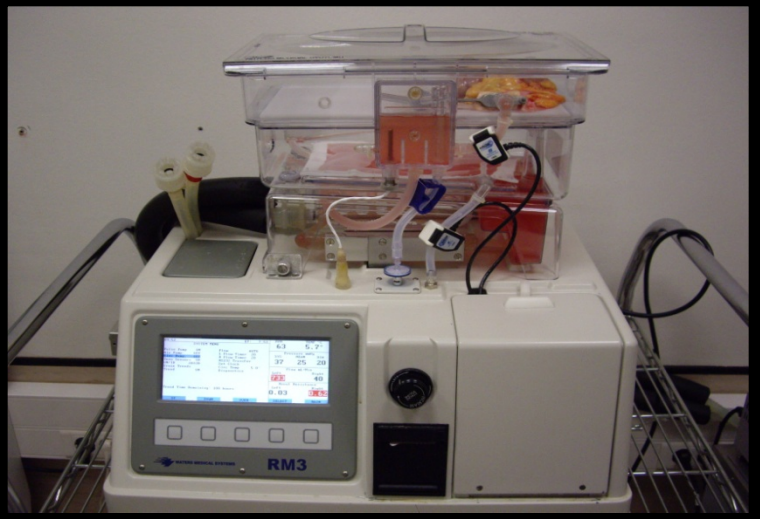


Kidneys (48 grafts)



38 kidneys
retrieved
underwent Machine
Perfusion(4-18 hs)

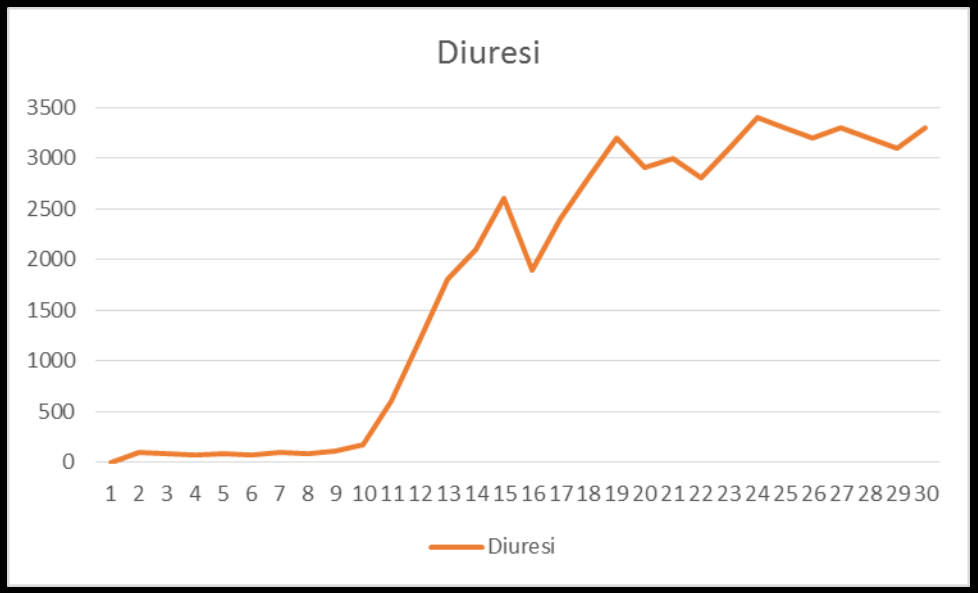
Kidneys with
resistance > 0.4
were excluded



27 grafts were
transplanted

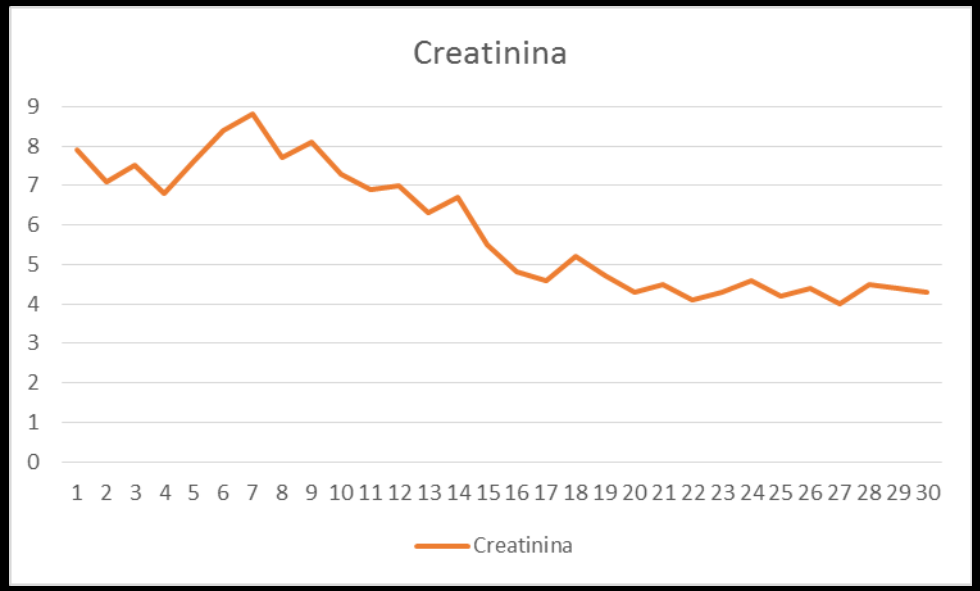
Advantages	Disadvantages
Lower incidence of DGF	Higher cost in the short term[a]
Continuous monitoring of parameters during perfusion	Endothelial injury is possible
Decreased intrarenal vasospasm	Possibility of graft damage[b]
Ability to provide metabolic support during perfusion	Logistically more complex
Potential for pharmacological manipulation	Possible equipment failure

Outcome



DGF :100%
PNF: 4% (1 pts)
1-year graft survival 98%
1-year patient survival 98%
5-year graft survival 98%
5-year patient survival 95%

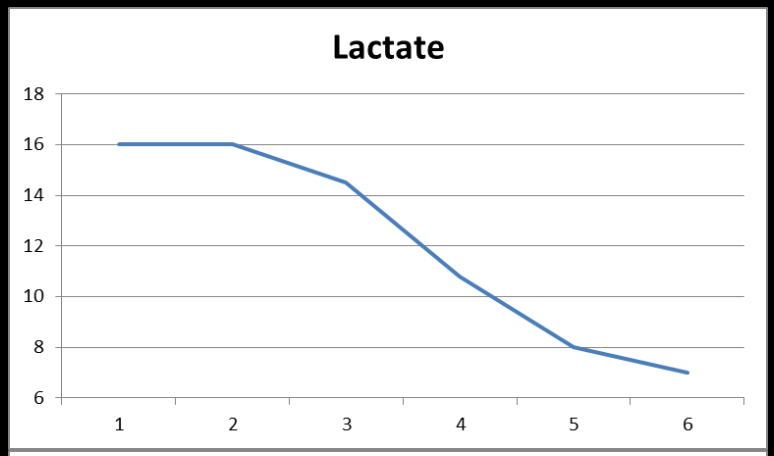
During the first month serum creatinine is high, but this improves with time as renal tubolar epithelium is regenerated

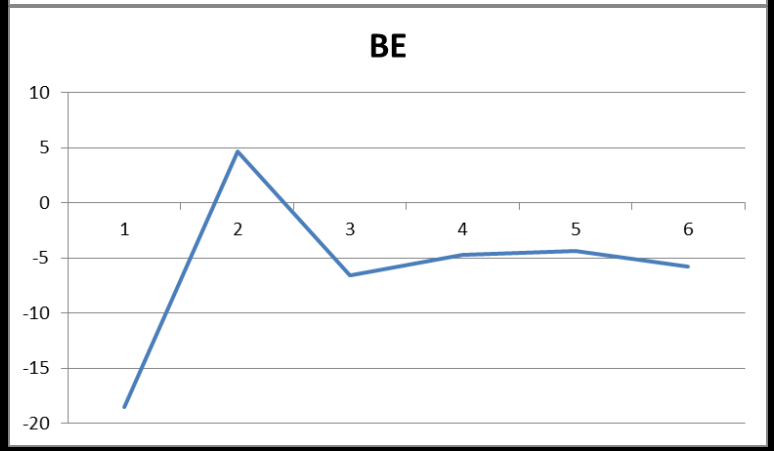


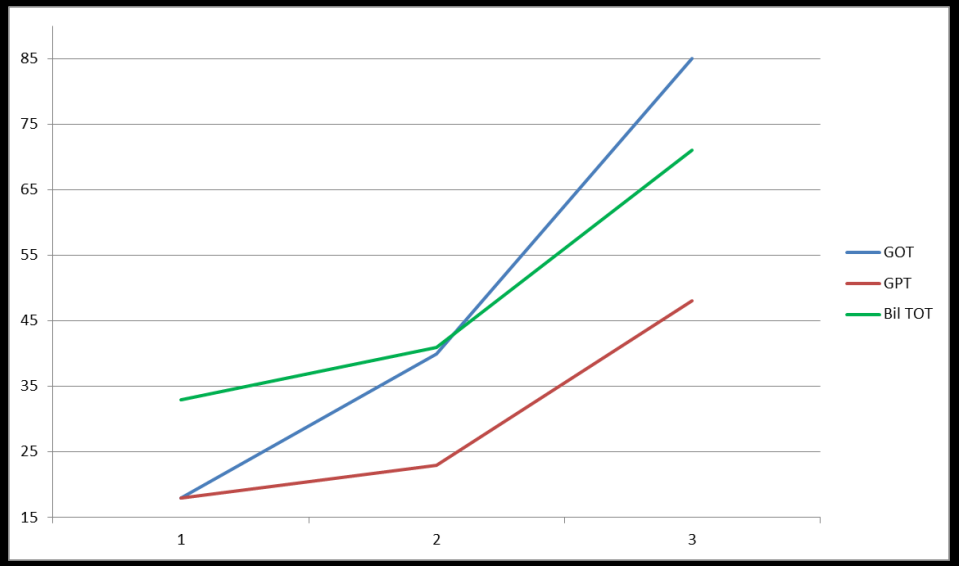
Liver

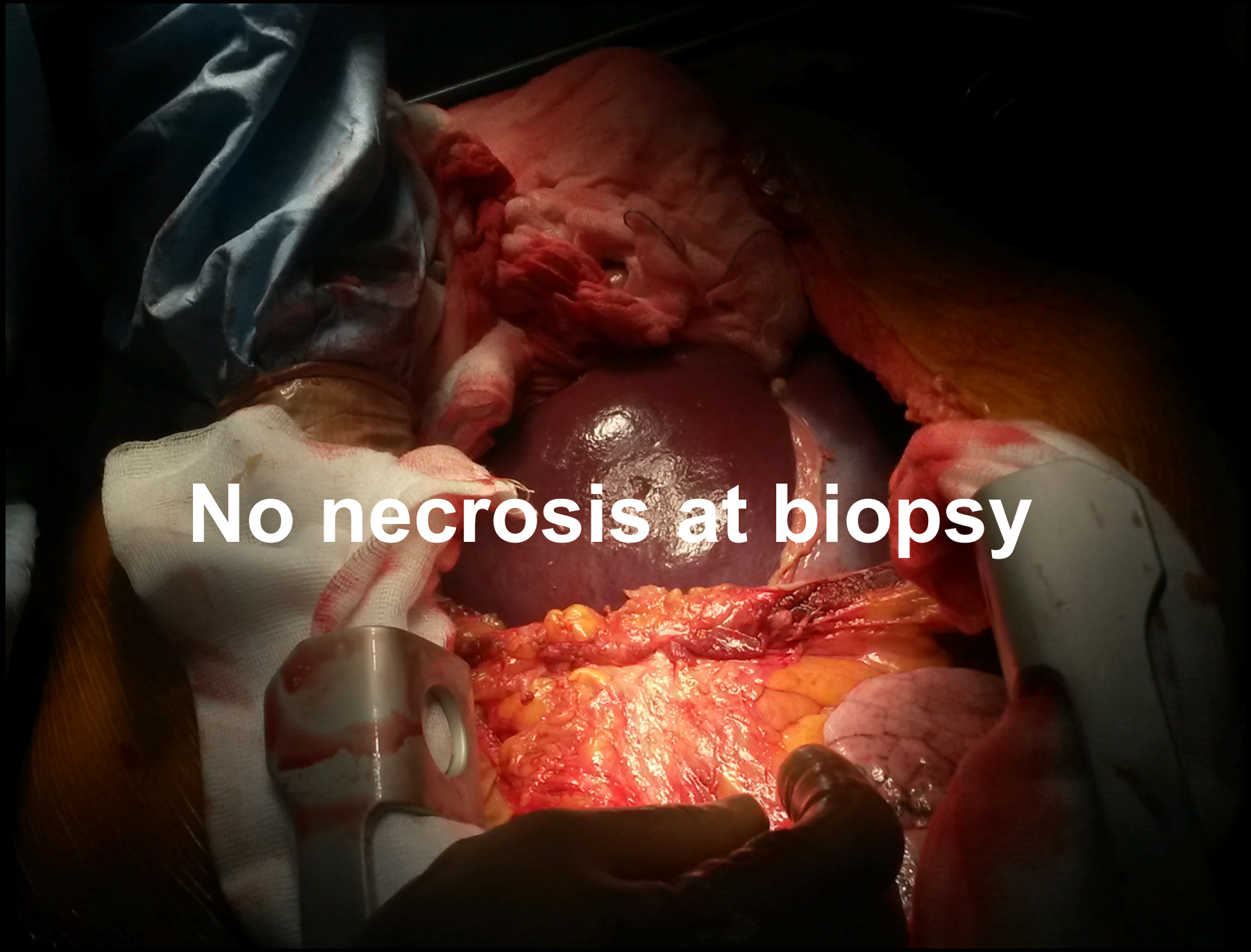
4 cases: 3 DCD II
1 DCD III

Function evaluation:
NRP for 6hs with ALT < 500 or drop > 40%
lactate < 5 mmmol/l or drop > 40%







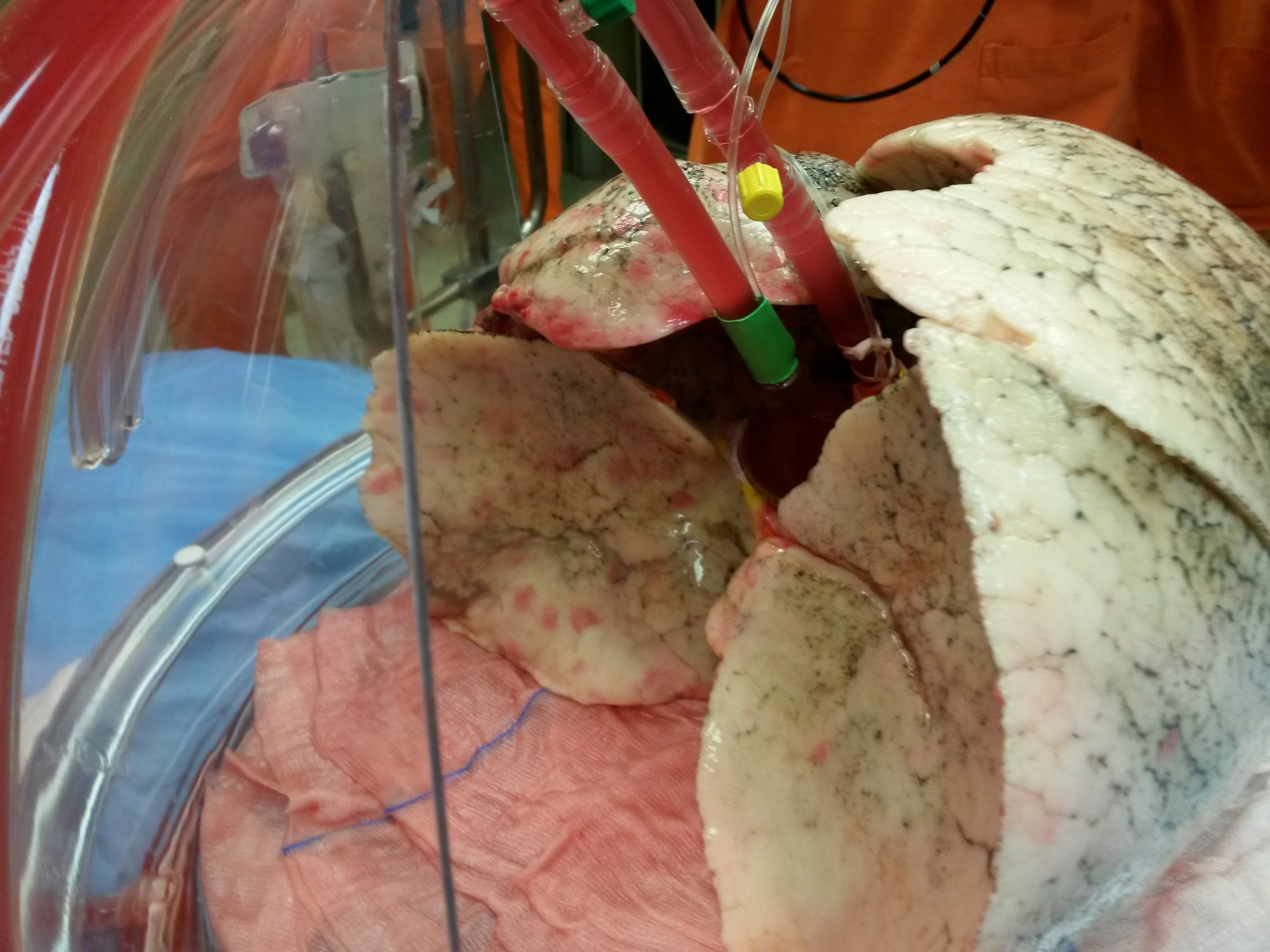

No necrosis at biopsy

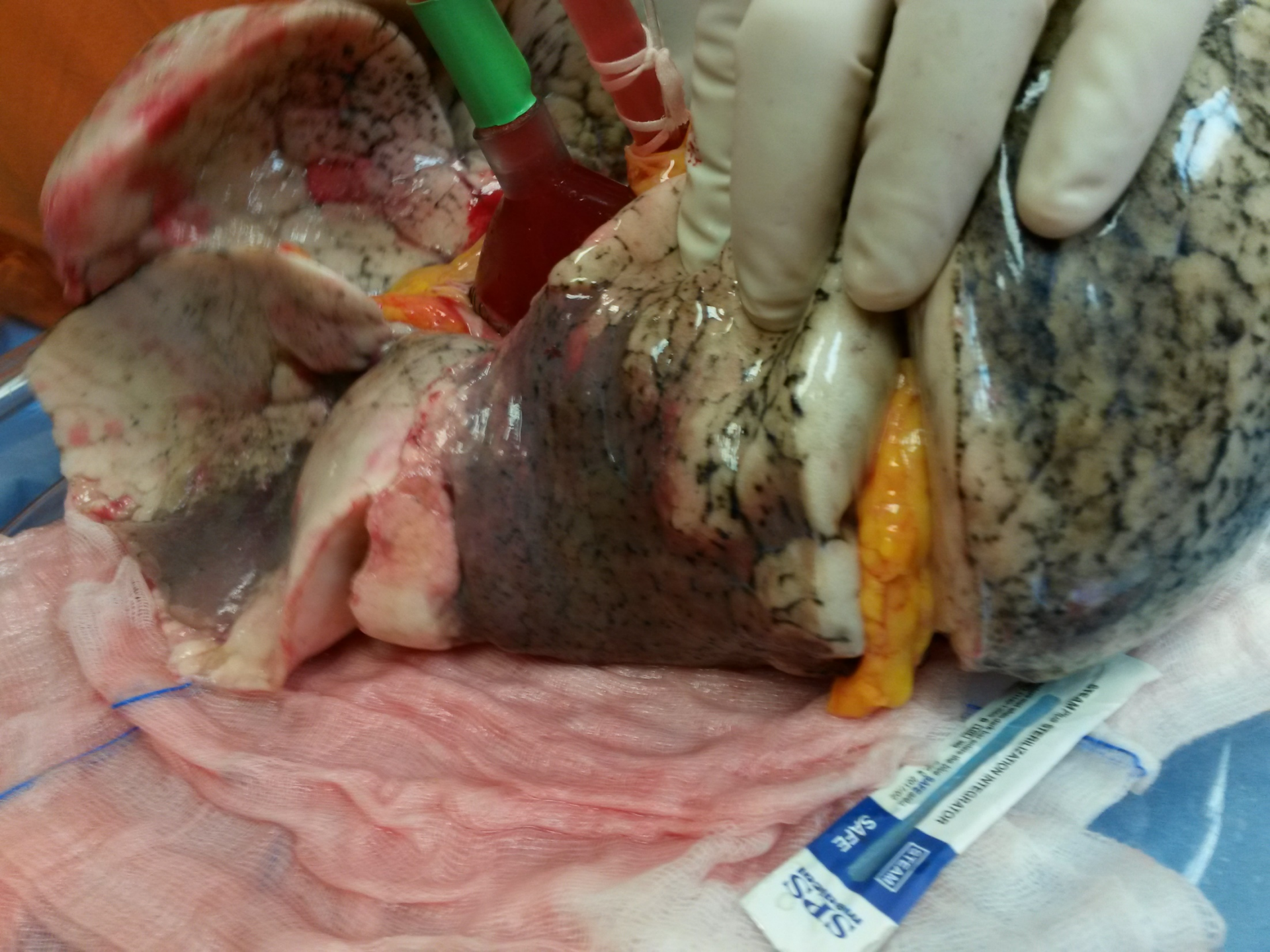
All four livers were perfused and evaluated for four hs with a perfusion machine
All four livers were successfully transplanted with good function
All four recipient are alive and well

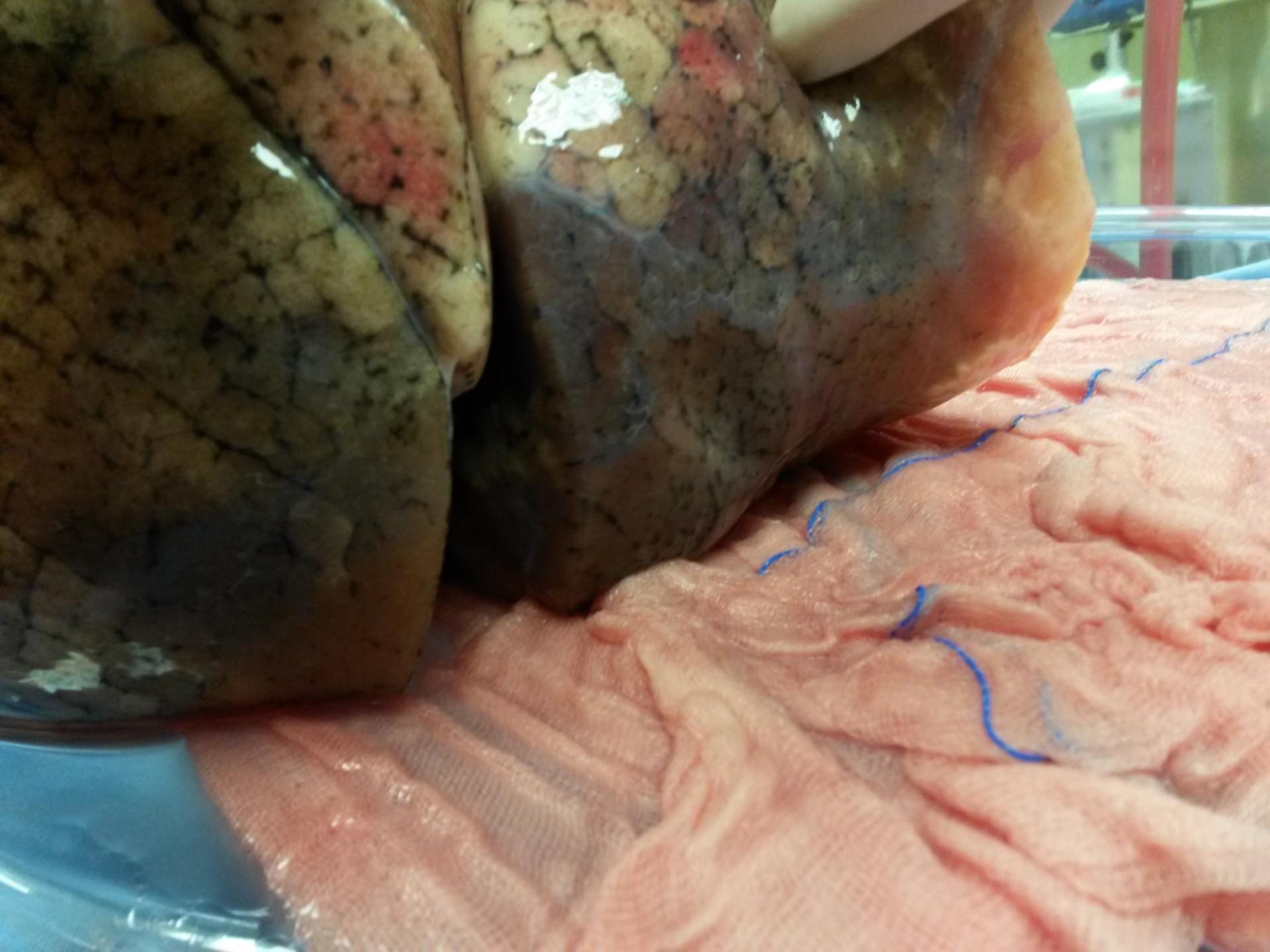
…..And the lungs?

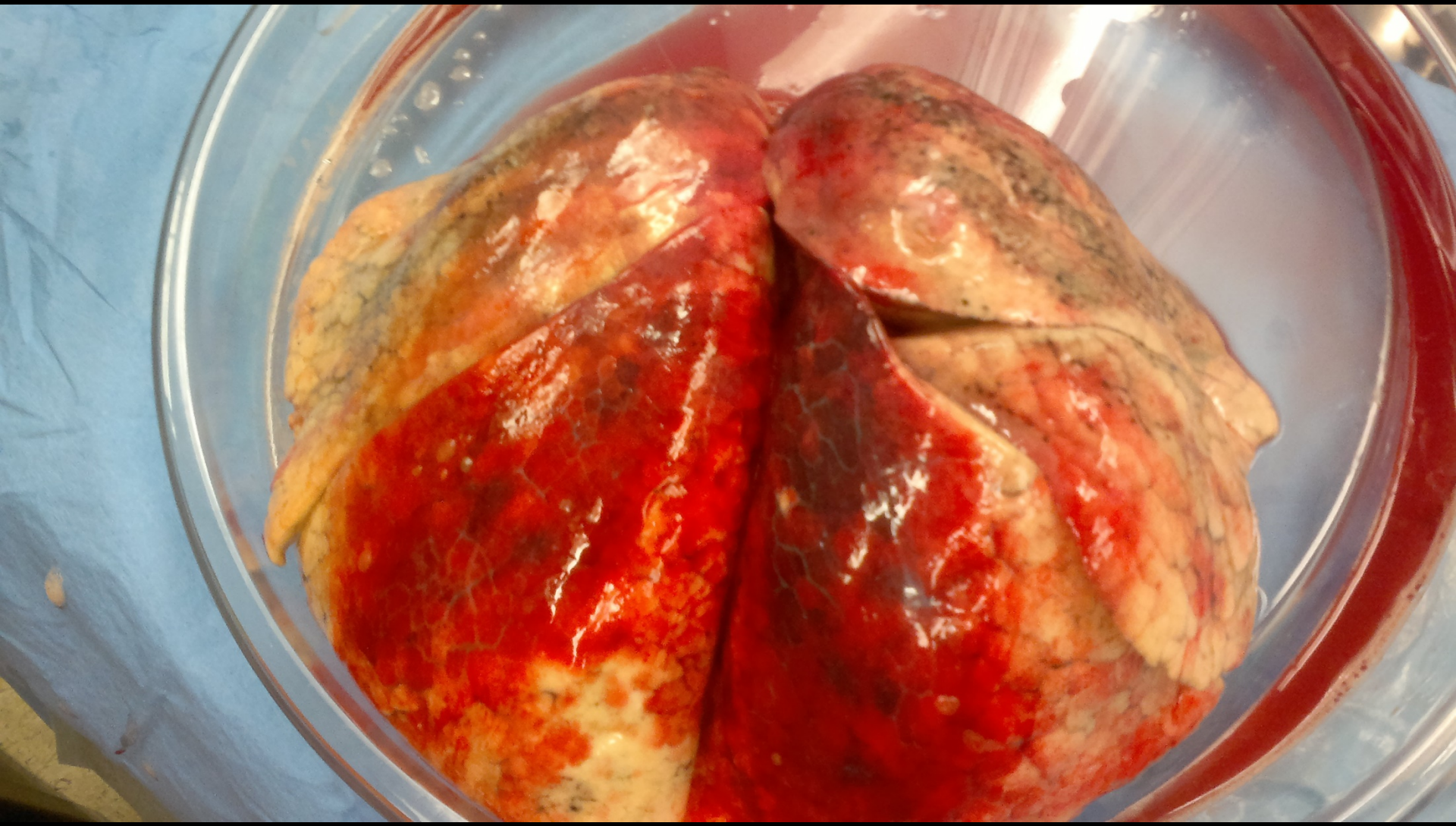
NRP can be performed simultaneouslly wthout compromising the outcome of both thooracic and abdominal organ transplants, but…..

The Journal of Heart and Lung Transplantation, Vol 31, No 4, April 2012




SAFE





Case Report

Successful transplantation of lungs from an uncontrolled donor after circulatory death preserved in-situ by alveolar recruitment maneuvers and assessed by ex-vivo lung perfusion

Franco Valenza[1,2,*], Giuseppe Citerio[3,4], Issue

Cardio-circulatory death

absence of respiration and pulse pressure after 5 min of no-touch
20 minutes of asystole on EKG.

↓

Exclusion criteria

↓

In situ Preservation

recruitment maneuvers - CPAP - low frequency protective ventilation

↓

evaluation

↓

Ex Vivo Lung Perfusion

reconditioning - evaluation

↓

Transplantation

↓

Follow-up

Conclusion 1

First, the question emerged about a conflict of interest between patient care and potential organ procurement. In this cohort, resuscitation duration was always longer than recommended. Secondly, to avoid any potential conflict of interest,

Specific time and legal constraints of this emergency procedure implied a highly coordinated multidisciplinary teamwork in order to preserve organ function.

Fieux F et al, Crit Care 2009; 13: R141

Conclusion 2

The key element of **in-situ NRP** is to mantain the organs in a normal physiological state providing oxygen and nutrients to support aerobic metabolism

There is the need to improve the quality of these graft by **ex-situ preservation technique** which increases the chance of immediate function after transplantation