Kidney Transplantation

Current issues and opportunities for MR imaging

Cyril Moers, transplant surgeon

umcg Transplantation
Comprehensive Transplant Center

University of Groningen – *since 1614*

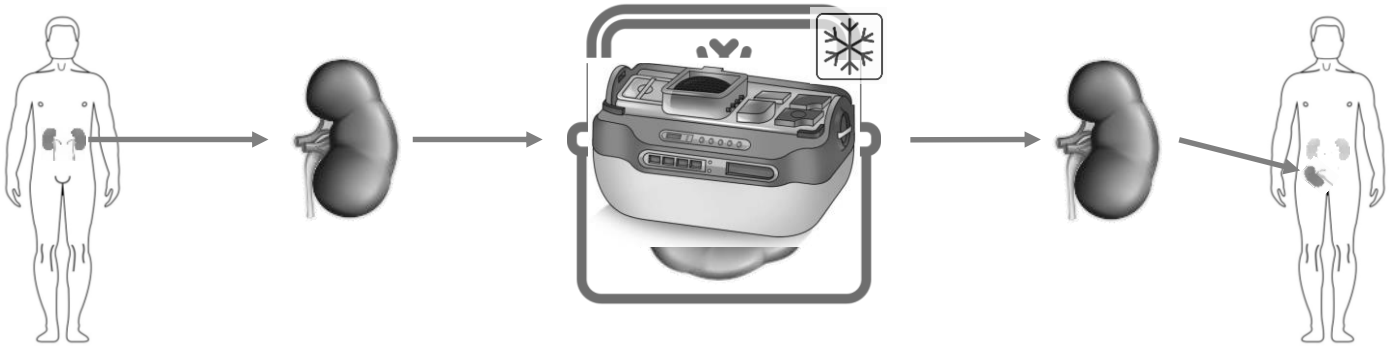
University Medical Center Groningen

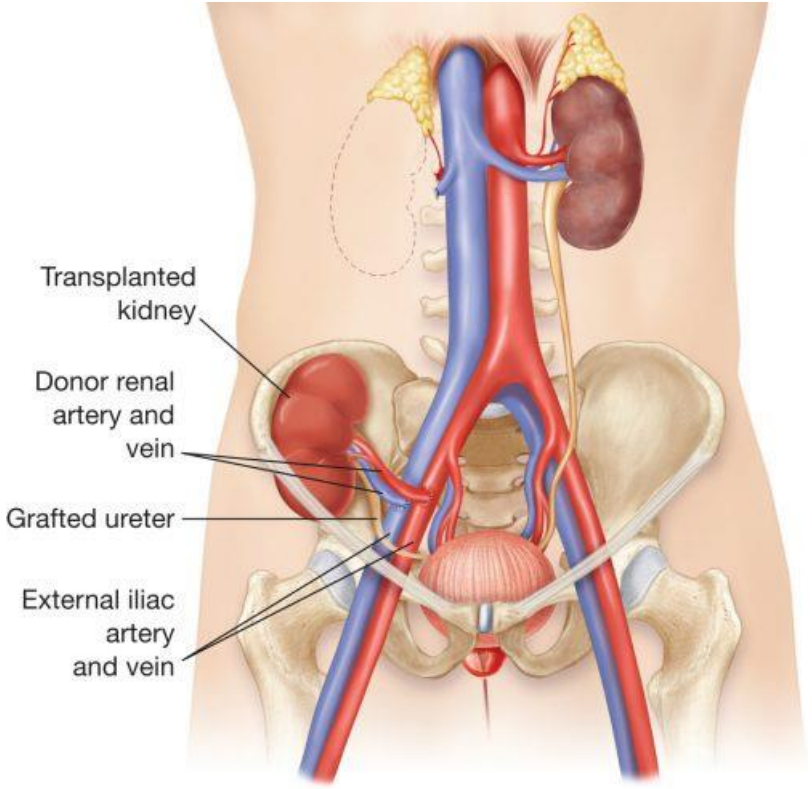
University Medical Center Groningen

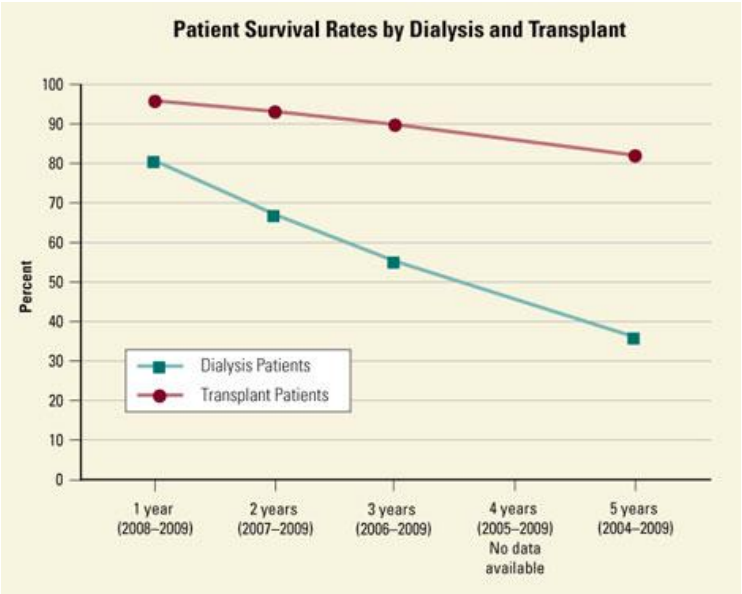
- Kidney (120 living, 80 deceased)
- Liver (10 living, 80 deceased)
- Pancreas (10)
- Small intestine (3)
- Lung (35)
- Heart (10)

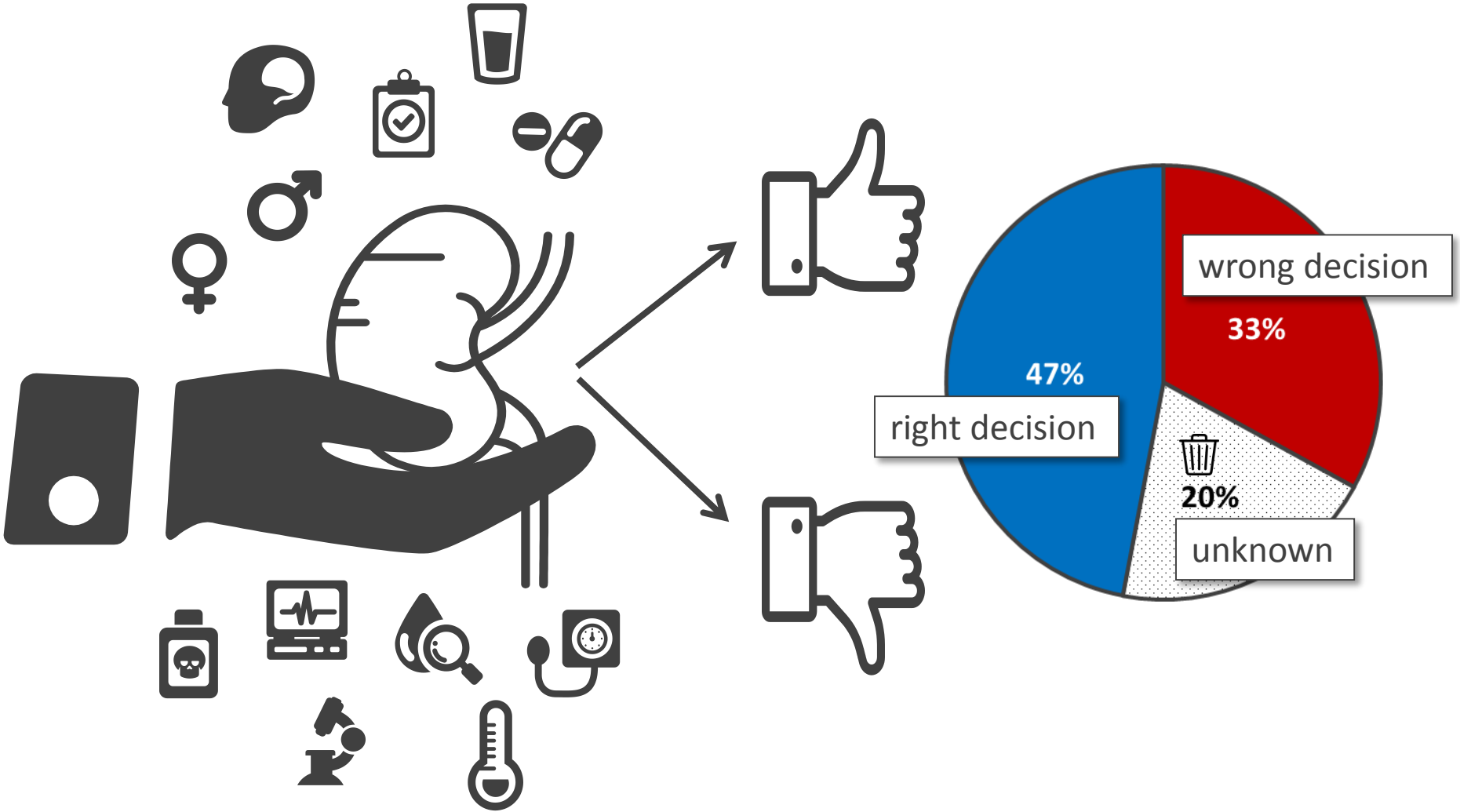
Organ preservation and resuscitation unit

donor organ preservation & transport recipient

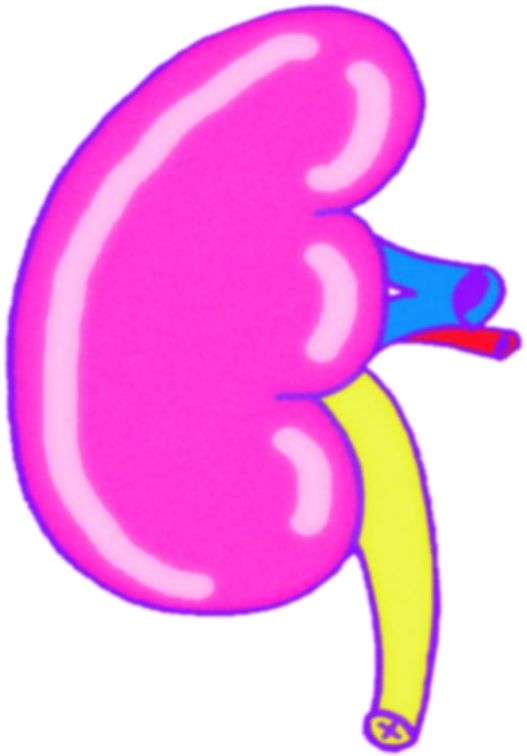



Transplanted kidney
Donor renal artery and vein
Grafted ureter
External iliac artery and vein


Patient Survival Rates by Dialysis and Transplant
Percent
100
90
80
70
60
50
40
30
20
10
0
Dialysis Patients
Transplant Patients
1 year (2008–2009)
2 years (2007–2009)
3 years (2006–2009)
4 years (2005–2009) No data available
5 years (2004–2009)


wrong decision
33%
47%
right decision
20%
unknown

Background



- There is a persistent donor organ shortage
- The typical organ donor today is older and has more comorbidities compared to 10 years ago
- Approximately 50% of potentially viable deceased donor kidneys are turned down locally, 20% discarded
- More than 30% of transplanted kidneys do not show acceptable outcome
- Current pre-transplant organ quality evaluation is based on *subjective* clinical assessment and unreliable
- There is an urgent need for *objective* pre-transplant organ assessment tools

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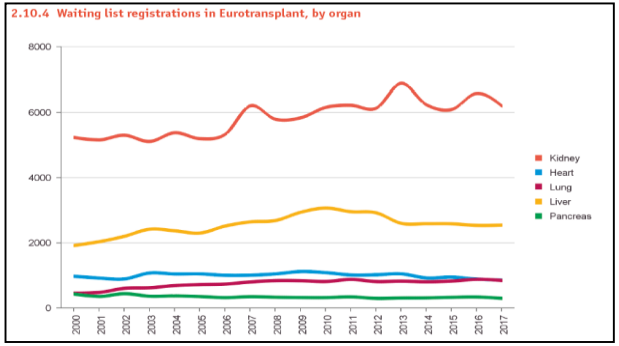

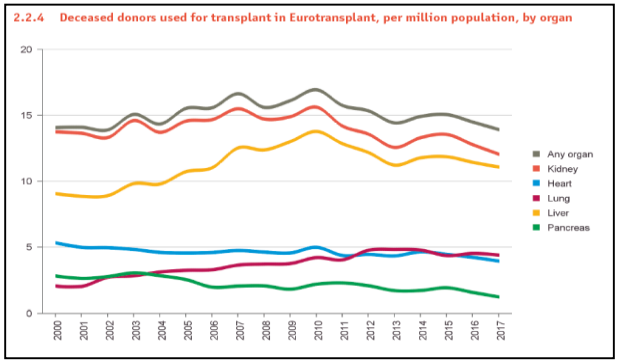

Eurotransplant Annual Report 2017

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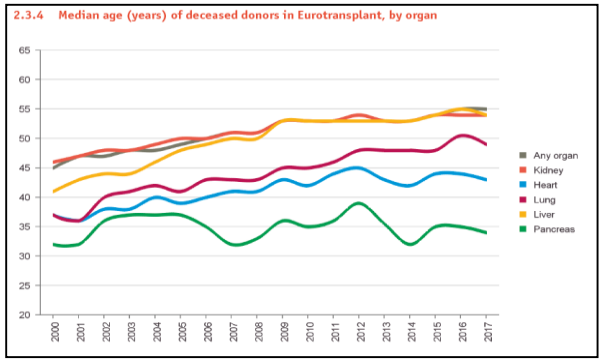

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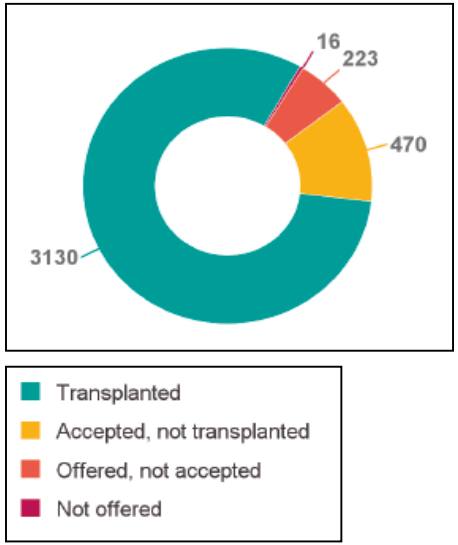

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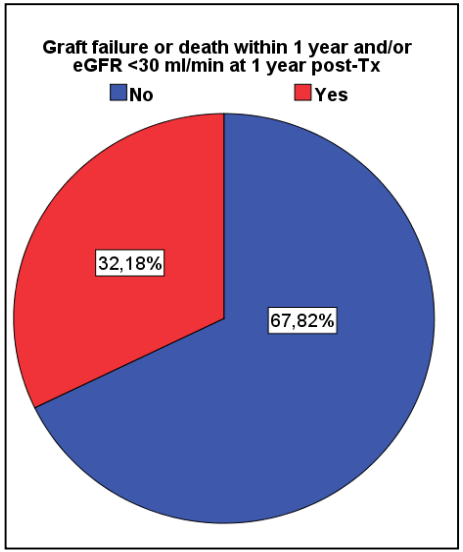

NOTR data 50+ donor cohort 2000-2015

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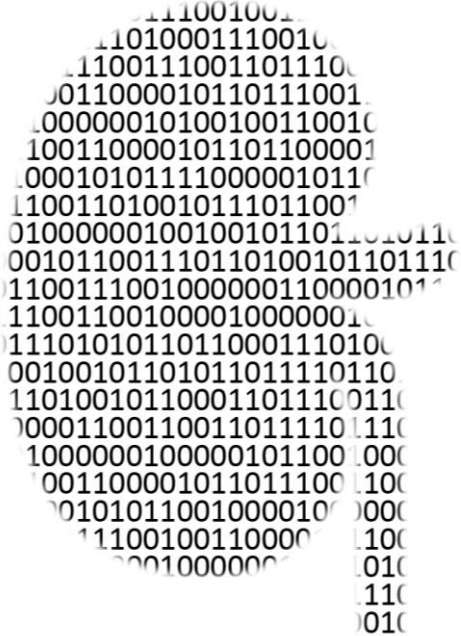

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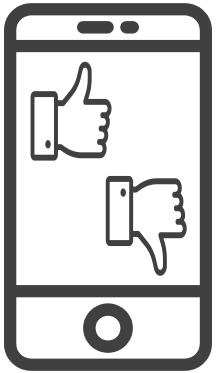
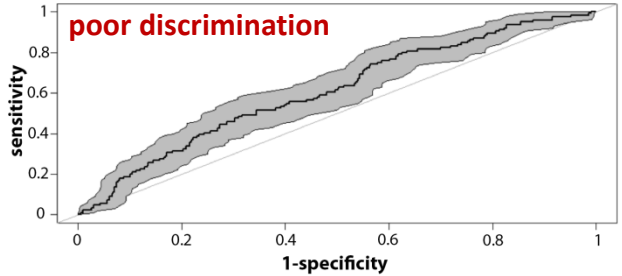
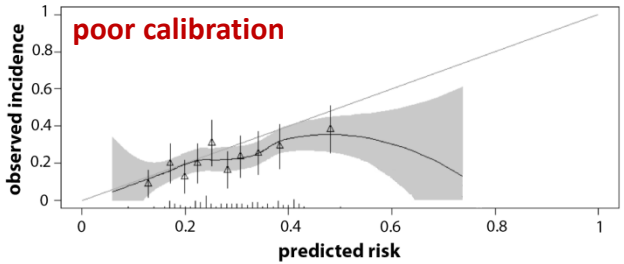
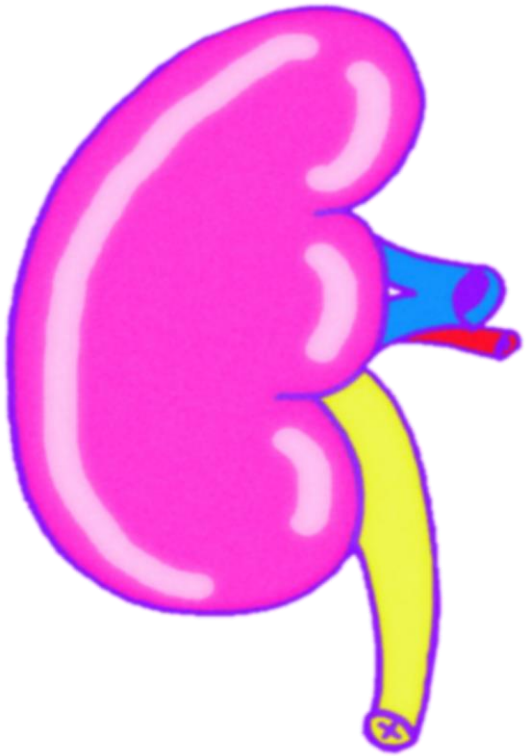


variance explained





Current state-of-the-art



- Prediction models for post-transplant outcome based on clinical variables alone and are unreliable
- Most kidneys are preserved on a hypothermic (0-8°C) machine perfusion (HMP) device, which yields better outcome versus static storage, but no reliable organ assessment
- Many centres are interested in *normo*thermic (37°C) ex vivo machine perfusion (NMP) as a platform for pre-transplant organ assessment
- But frankly, we have no idea what parameters and biomarkers during NMP tell us about kidney quality

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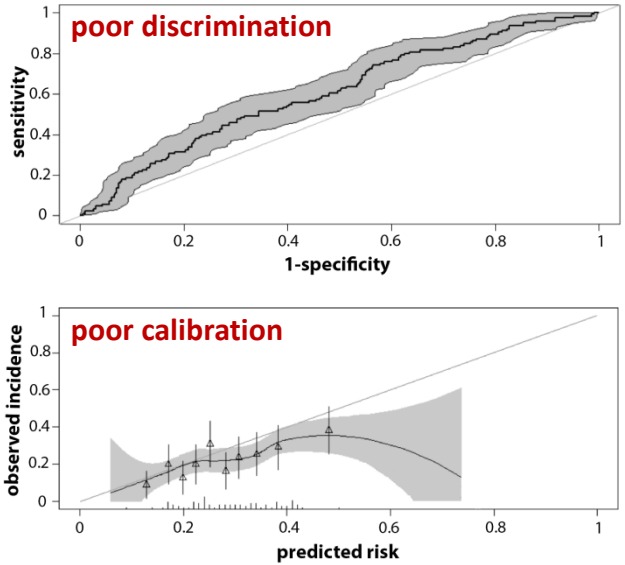

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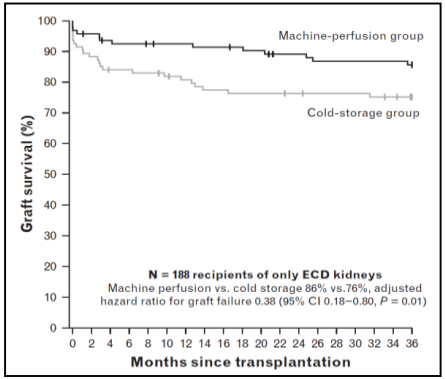
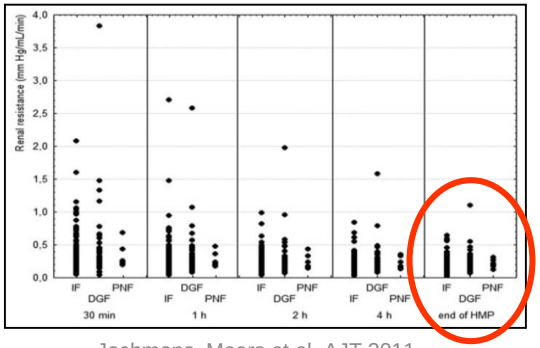


Moers et al, NEJM 2009 & 2012



Jochmans, Moers et al, AJT 2011

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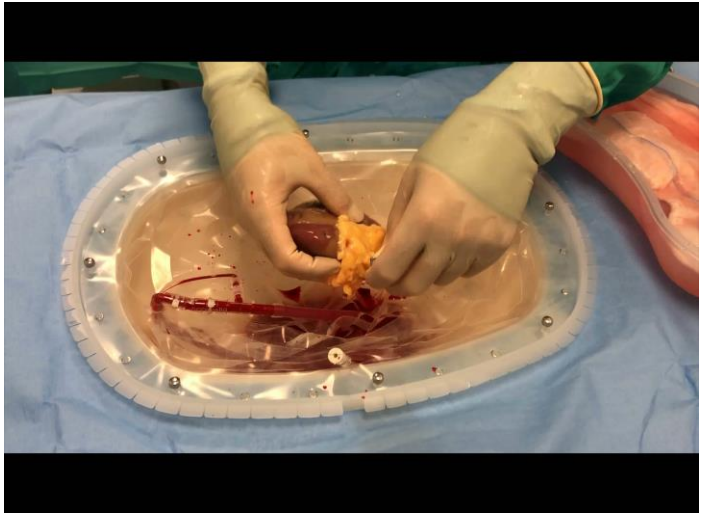

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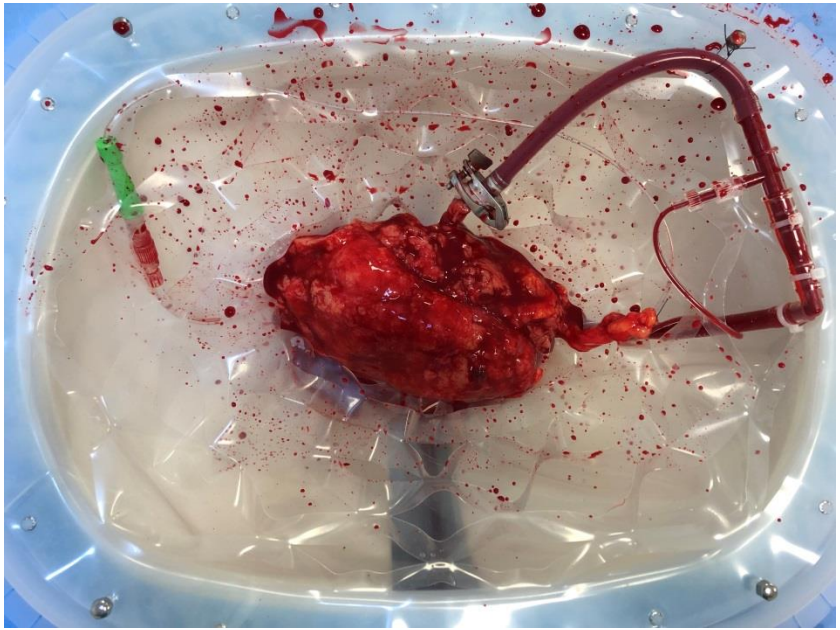
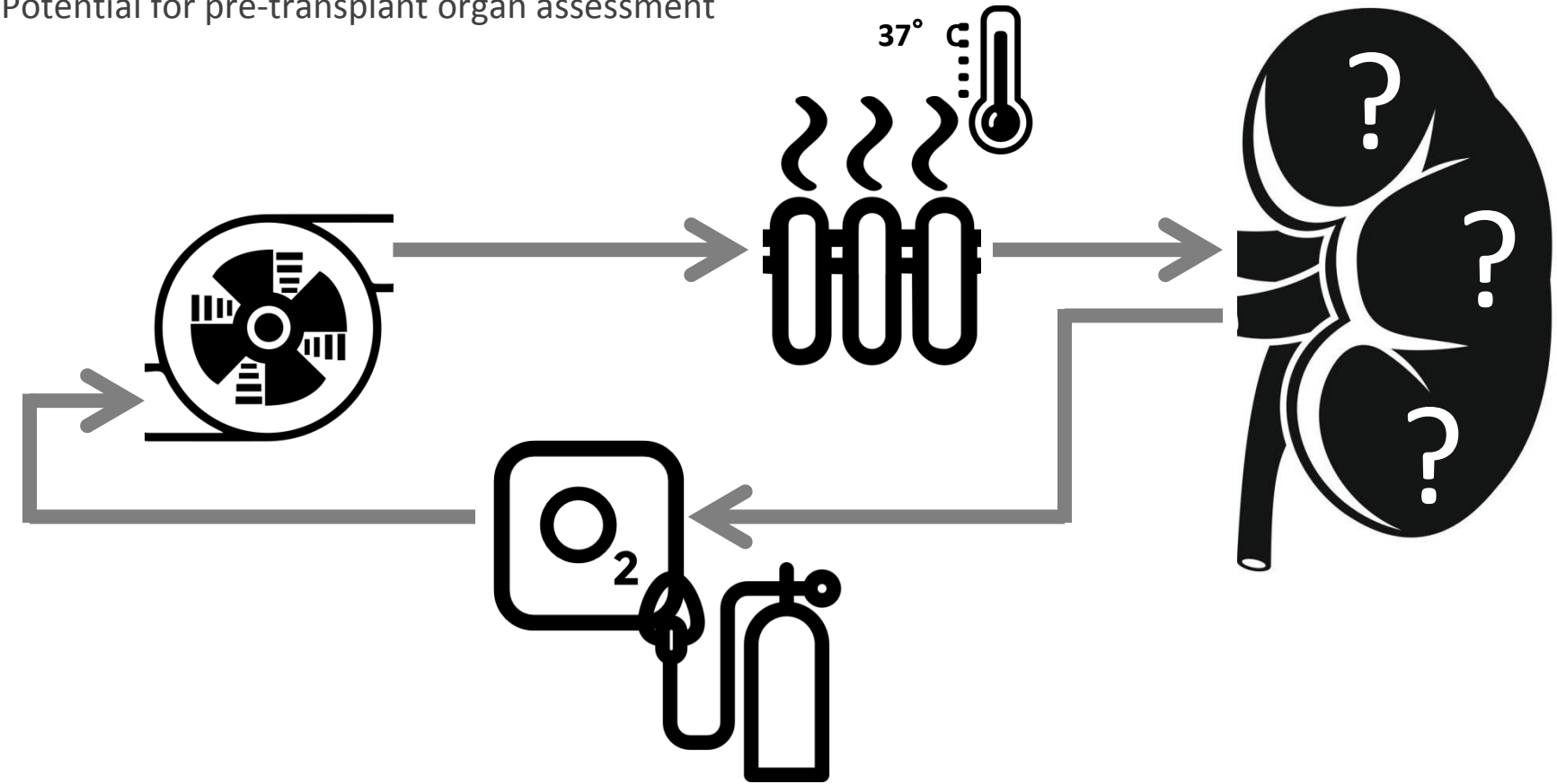
Ex vivo kidney perfusion

Potential for pre-transplant organ assessment



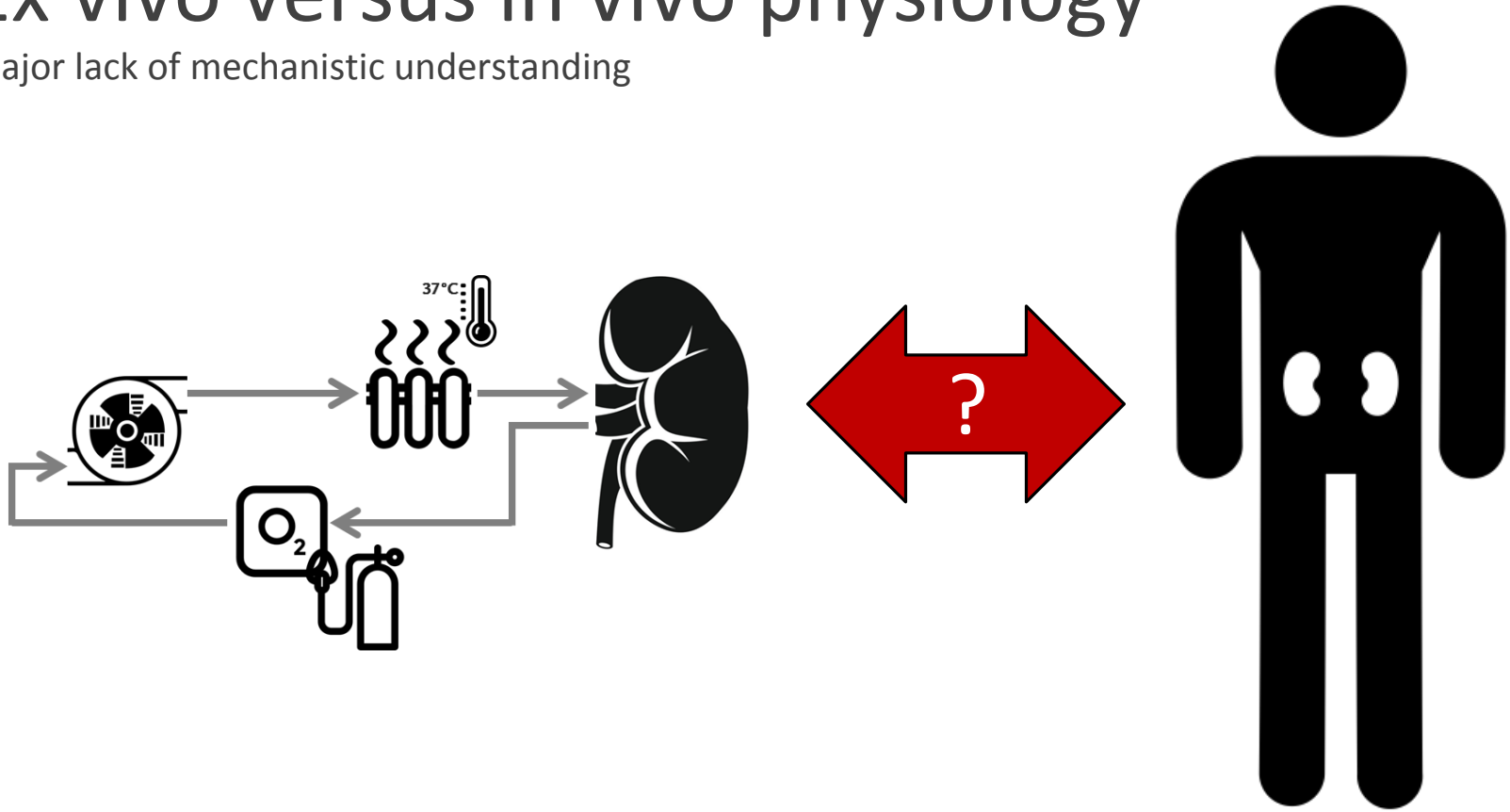
Ex vivo kidney perfusion

Potential for pre-transplant organ assessment



Ex vivo versus in vivo physiology

Major lack of mechanistic understanding



Normothermic MP as a diagnostic tool

Table 1 *Ex vivo* normothermic perfusion assessment score

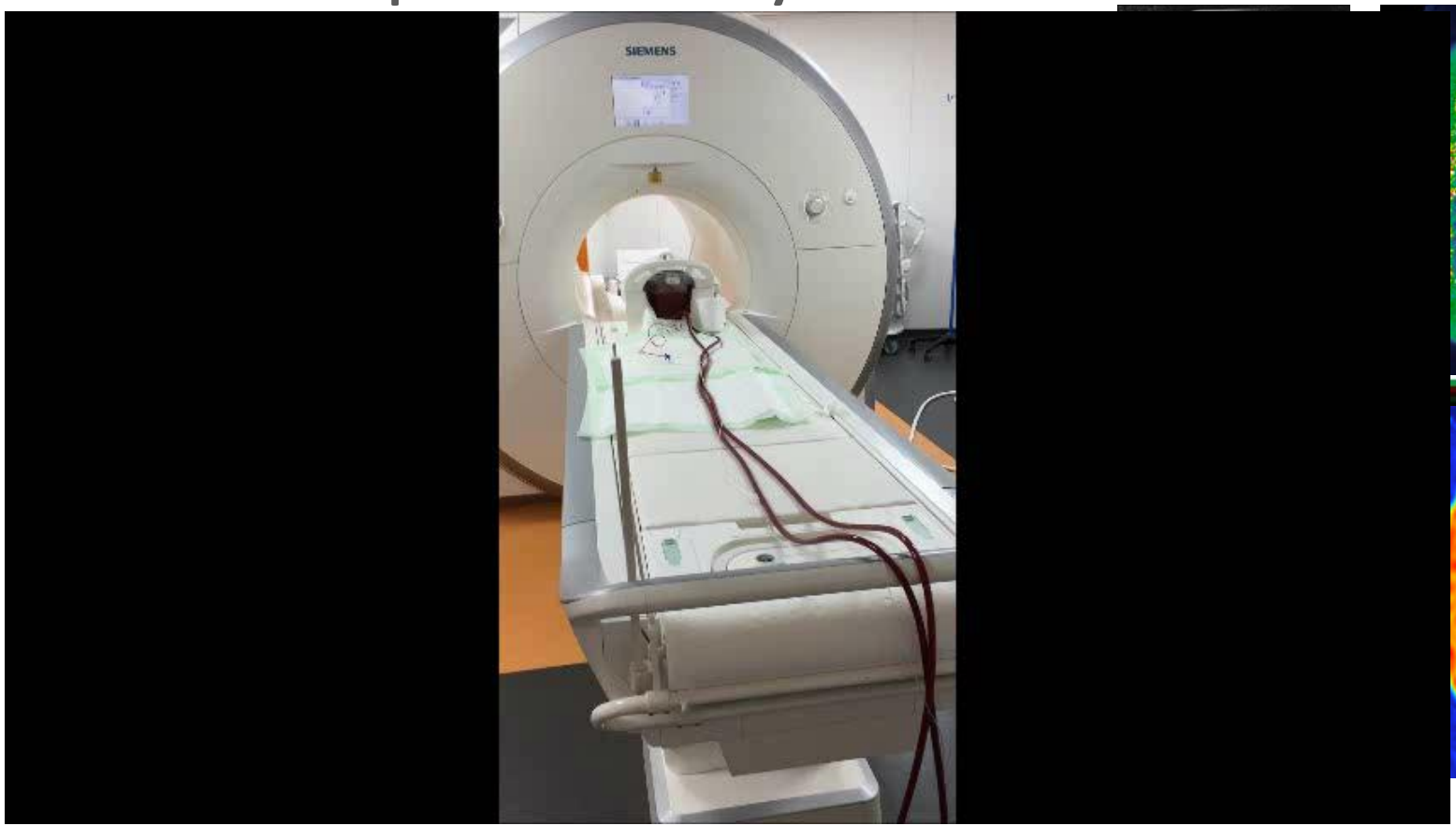
	Score
Macroscopic assessment	
Grade I: excellent perfusion (global pink appearance)	1
Grade II: moderate perfusion (patchy appearance)	2
Grade III: poor perfusion (global mottled and purple/black appearance)	3
Renal blood flow (ml per min per 100 g)	
Threshold ≥ 50	0
Threshold < 50	1
Total urine output	
Threshold ≥ 43	0
Threshold < 43	1

Hosgood et al. Am J Transpl 2016 and Br J Surg 2015

Urgent requirements

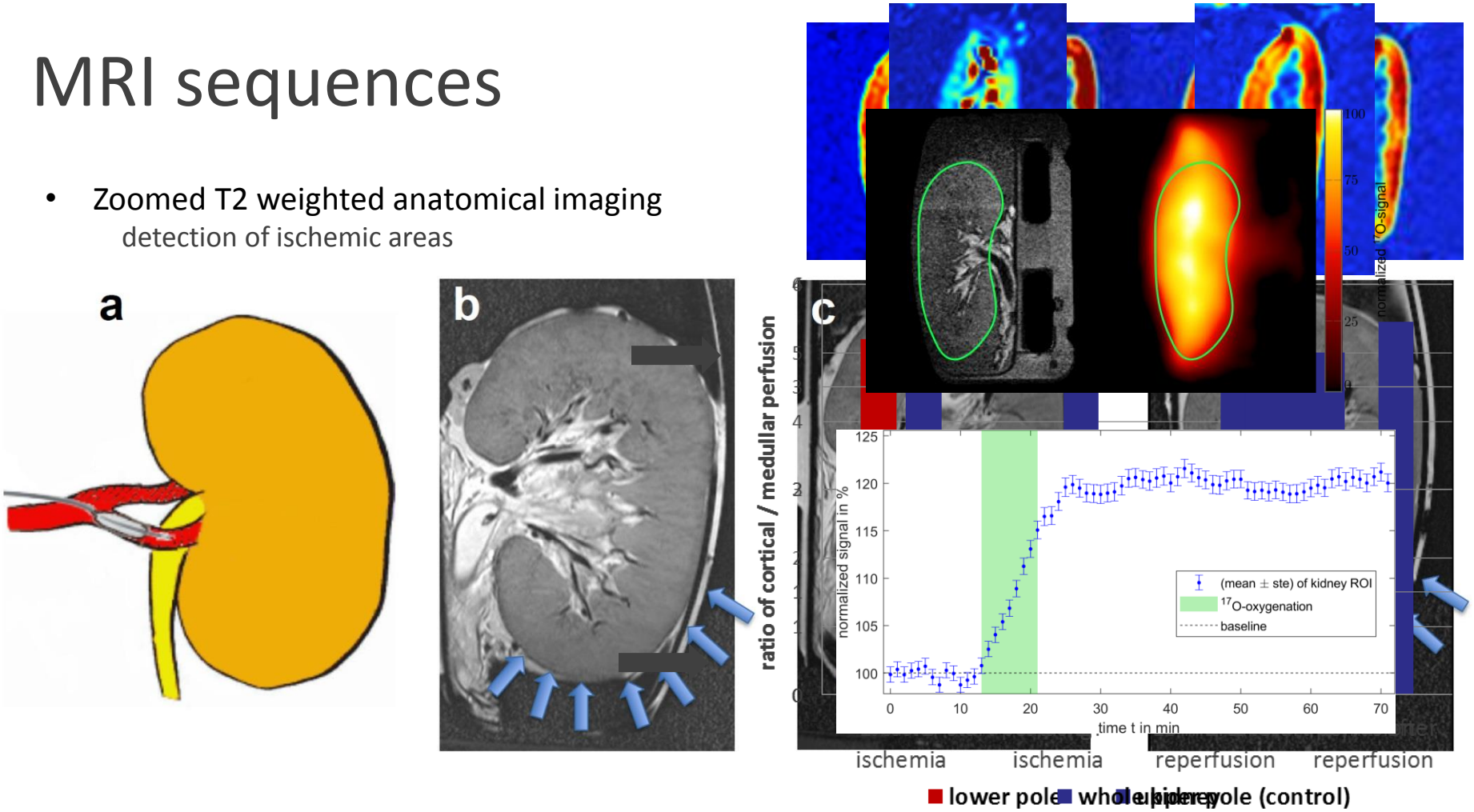
- **Better understand the molecular mechanisms that characterise ex vivo kidney perfusion**
- **Discover which parameters, biomarkers and molecular pathways are relevant for ex vivo pre-transplant organ assessment**

Prior and preliminary work



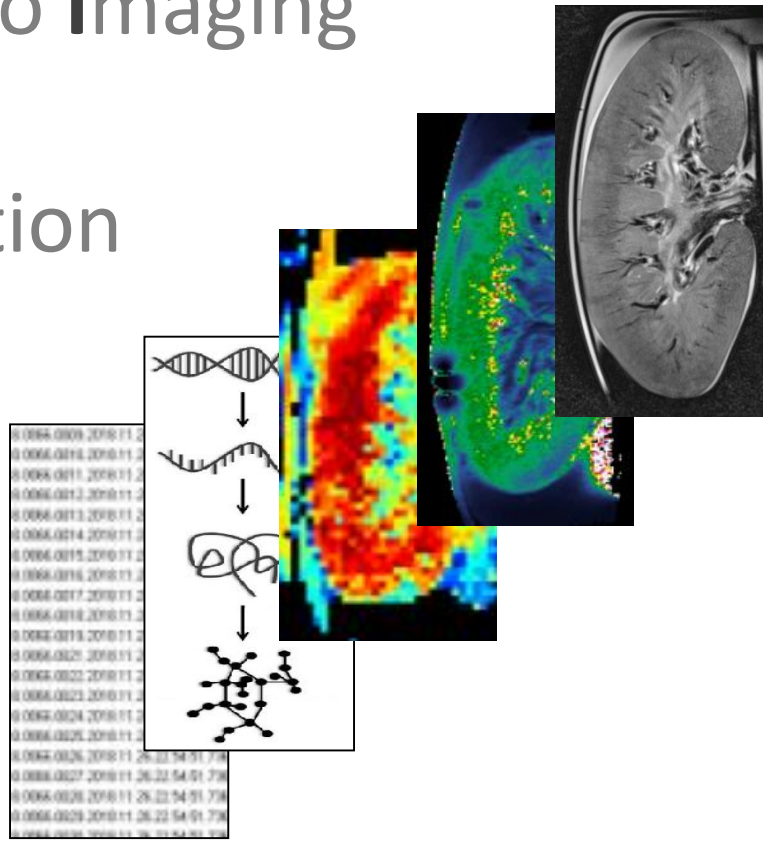
MRI sequences

- Zoomed T2 weighted anatomical imaging
  detection of ischemic areas



Pre-transplant **R**enal **E**x vivo **I**maging and **M**ulti-omics for **A**dvanced **G**raft **E**valuation

PRE-IMAGE



Cyril Moers

Transplant surgeon and tenure track researcher

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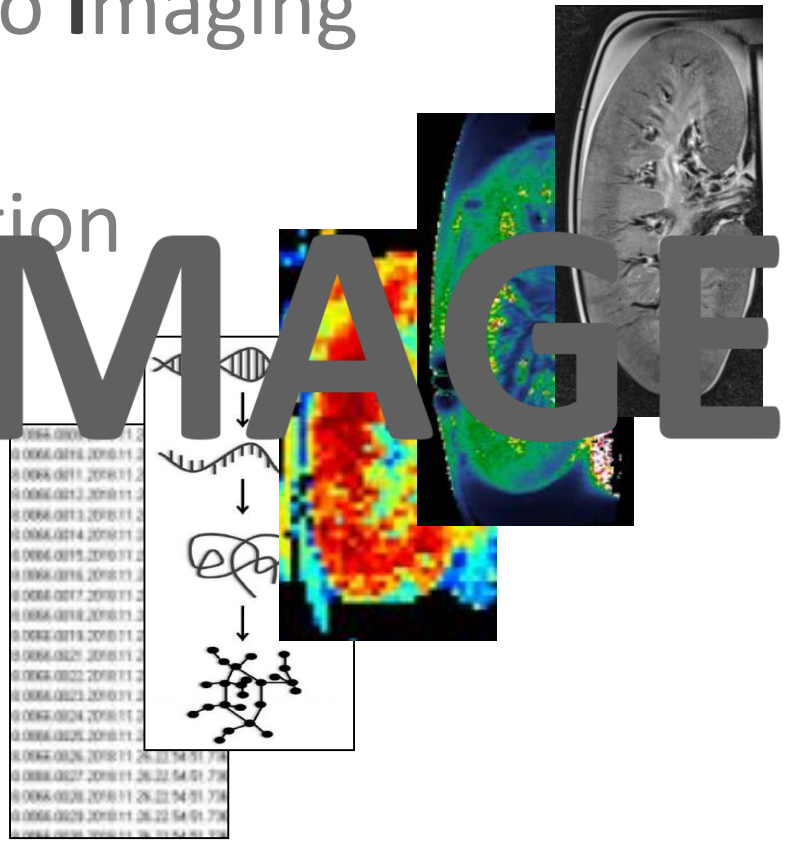

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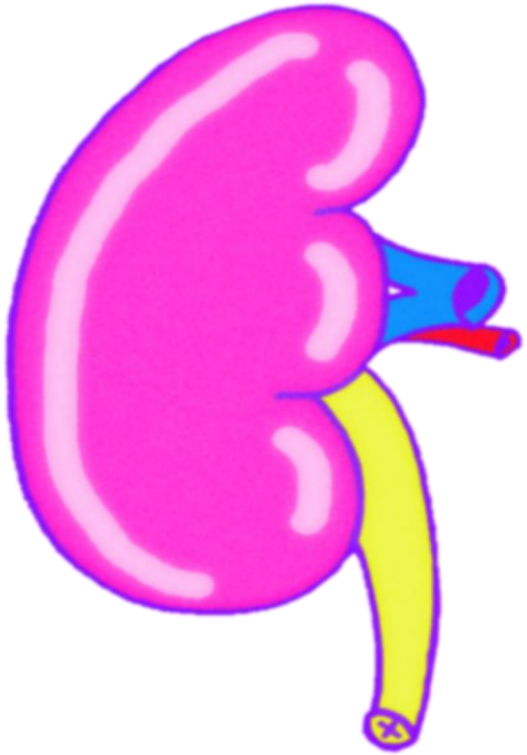
Post-transplant opportunities for MRI



- Assessment of renal perfusion
  - Replace observer-dependent ultrasound
  - Better pinpoint cause of perfusion problems
  - Less invasive vs. CT-angiography
- Early graft dysfunction
  - Replace invasive diagnostics
  - Early differentiation of causes
  - Rapid onset of targeted therapy
- Urological complications
  - Replace invasive diagnostics
- Long term graft monitoring

Team

Cyril Moers
surgeon, junior PI
Henri Leuvenink
senior PI
Sijbrand Hofker
transplant surgeon
Christina Krikke
transplant surgeon
Robert Pol
transplant surgeon
Mostafa El Moumni
surgeon/statistician
Petra Ottens
biotechnician
Merel Pool
PhD student
Tim Eertman
student
Rianne Schutter
PhD student
Leonie Venema
PhD student
Aukje Brat
PhD student
Kate Lewis
PhD student
Veerle Lantinga
student
Leonie van Leeuwen
PhD student
Tim Hamelink
student
Rinse Ubbink
OPR technician

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Loes Hartveld
student
Liset Wijngaards
student
Jaël Vos
student

Stefan Berger
nephrologist
Jan-Stephan Sanders
nephrologist
Meindert Crop
nephrologist

AARHUS UNIVERSITY

Bente Jespersen
senior PI
Christoffer Laustsen
MRI specialist
Marco Eijken
postdoc researcher
Ulla Møldrup
urologist
Stine Lohmann
PhD student
Anna Krarup Keller
urology registrar
Stina Lignell
student

Erasmus MC
University Medical Center Rotterdam

Martin Hoogduijn
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Jesus Sierra-Parraga
PhD student
Robert Minnee
surgeon

LUMC

Marlies Reinders
senior PI
Volkert Huurman
transplant surgeon
Asel Arykbaeva
PhD student

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Rutger Ploeg
senior PI
Maria Kaisar
PhD student
Benedikt Kessler
proteomics specialist
Honglei Huang
proteomics specialist
James Hunter
postdoc researcher

DUTCH TRANSPLANT FOUNDATION

Andries Hoitsma
nephrologist
Cynthia Konijn
data manager
Nichon Jansen
senior researcher

erc

ZonMw

NIERSTICHTING

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Thank you for your attention!

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Comprehensive Transplant Center