Hypothermic machine perfusion for kidneys

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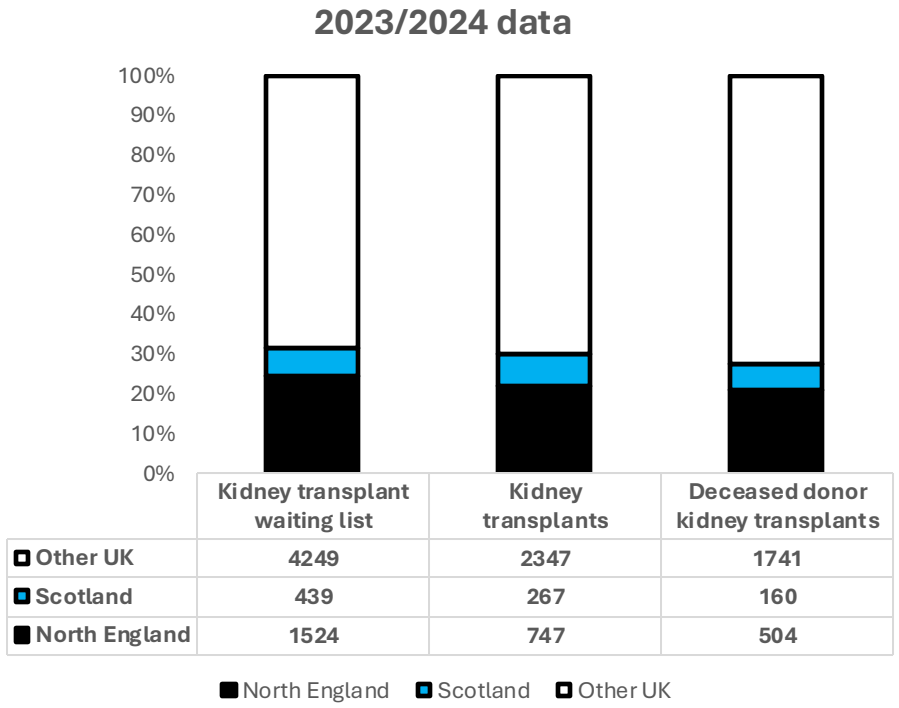
Introduction

- **6212** patients active on UK waiting lists for kidney transplantation as of March 2024
- **3361** transplants performed in the UK between March 2023/2024
- **2405** adult deceased donor kidney transplants in that period (71.5%)
- National decline rates
  - SCD DBD 55%
  - ECD DBD 62%
  - DCD 60%



	Kidney transplant waiting list	Kidney transplants	Deceased donor kidney transplants
Other UK	4249	2347	1741
Scotland	439	267	160
North England	1524	747	504

Scotland and North of England contribute 28-31%)

Introduction

- The incidence of DGF is significantly higher in deceased donors. Approximately 44% and 31% in cDCD and DBD kidneys respectively (vs 5% in living donors)
- **Prolonged DGF** and **12-month eGFR below 45 mL/min** are significant predictors of graft failure*

*Transplant and Recipient Factors in Prediction of Kidney Transplant Outcomes: A UK-Wide Paired Analysis.
Dumbill R, Jaques R, Robb M, Johnson R, Ploeg RJ, Kaisar ME, Sharples EJ. J Clin Med. 2022 Apr 15;11(8):2222. doi: 10.3390/jcm11082222.

Hypothermic Machine Perfusion (HMP)
The current evidence

Cochrane Library

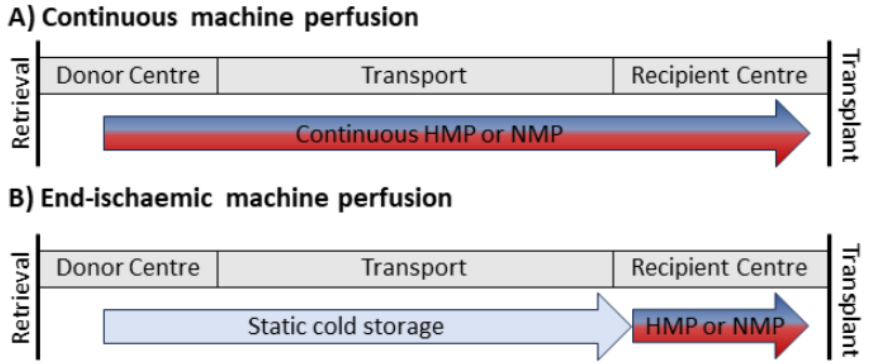
Cochrane Database of Systematic Reviews

Normothermic and hypothermic machine perfusion preservation versus static cold storage for deceased donor kidney transplantation (Review)

Tingle SJ, Thompson ER, Figueiredo RS, Moir JAG, Goodfellow M, Talbot D, Wilson CH.
Normothermic and hypothermic machine perfusion preservation versus static cold storage for deceased donor kidney transplantation.
Cochrane Database of Systematic Reviews 2024, Issue 7. Art. No.: CD011671.
DOI: 10.1002/14651858.CD011671.pub3.

Summary of review

- Oxygenated and non-oxygenated perfusion
- Continuous and end-ischaemic (back at base) perfusion



- Included 22 RCTs (4007 participants)

19 RCTs

Non-oxygenated HMP vs Static cold storage (SCS)

1 RCT

Oxygenated HMP vs **non-oxygenated** HMP

1 RCT

Oxygenated HMP vs Static cold storage (SCS)

- Risk of bias generally low across all studies and bias domains

Summary of results

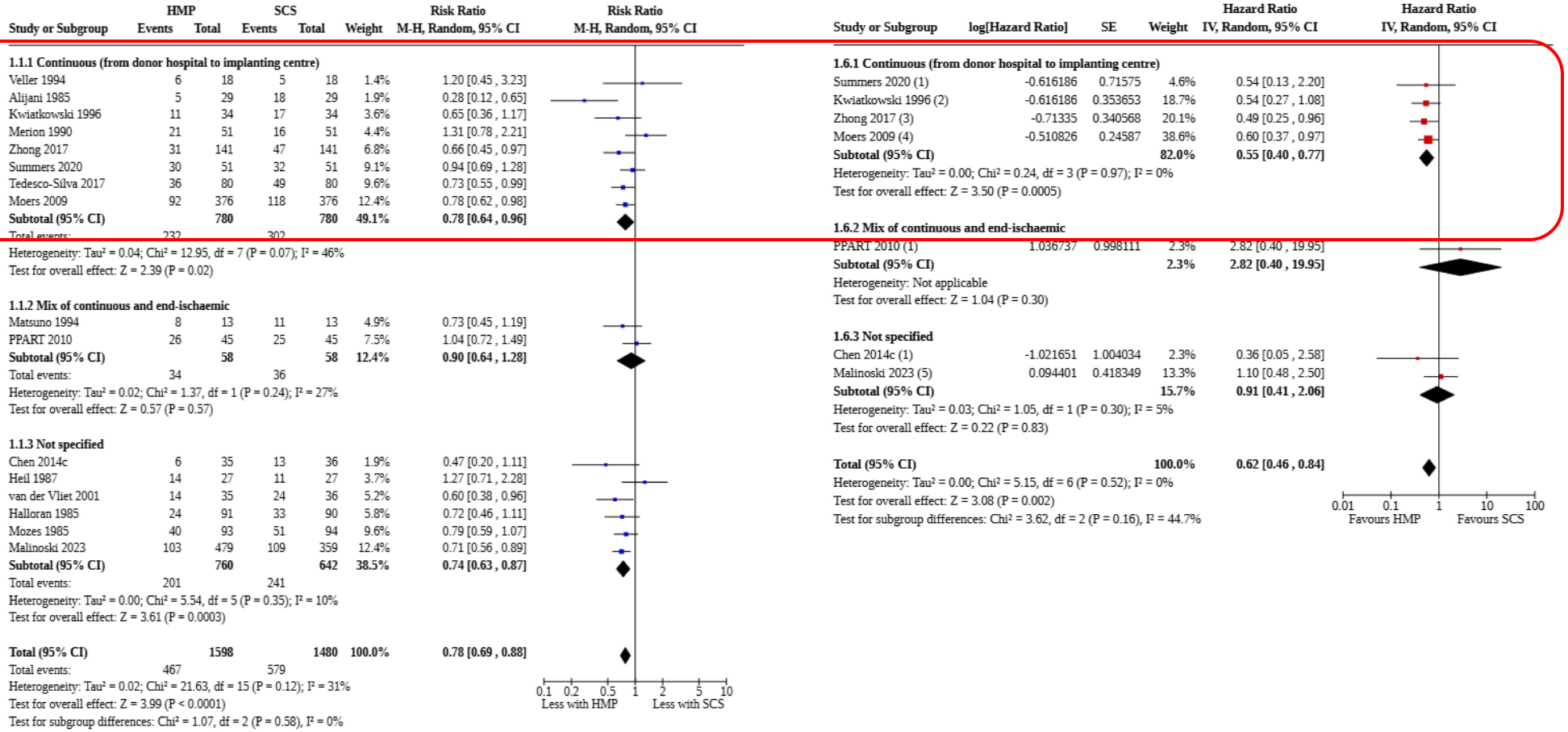
Non-oxygenated HMP versus SCS

- Reduces the rate of **DGF** in both DCD and DBD setting
- Improves one-year and maximal follow-up **graft survival**
- Benefit seen with continuous HMP and not in end-ischaemic HMP
- The number of perfusions required to prevent one episode of DGF was 7.69 and 12.5 in DCD and DBD grafts, respectively

Oxygenated continuous HMP versus non-oxygenated HMP

- Additional benefits in DCD donors (> 50 years)
- Further improvements in **graft survival**
- Improved **one-year kidney function**
- Reduced **acute rejection**

Delayed graft function



: Graft survival (at maximum follow-up)

Portable hypothermic machine perfusion technologies

LifePort (Organ Recovery Systems)
Pressure-driven
Oxygenated and non-oxygenated perfusion
Preoxygenation

Kidney Assist (OrganAssist)
Pressure-driven
Oxygenated perfusion
Continuous oxygenation

Newcastle’s experience

- Long term experience with end-ischaemic HMP kidney perfusion (LifePort)
- Mainly for logistical purposes (theatre or team availability)
- Use has declined over the past 10 years

- Now using continuous HMP for kidneys retrieved by the Newcastle NORS team
- This constitutes approximately 10-17% of all kidneys transplanted in Newcastle

Vision

The establishment of a national service for continuous HMP of deceased donor kidneys (when NRP is not used) embedded within the current NORS service and a potential future ARC service

Comparable international models

- **The Netherlands**

  Continuous nonoxygenated HMP has been the standard of care for deceased donor kidneys since 2016

- **France**

  A nationwide continuous nonoxygenated HMP program for ECD kidney transplants introduced from 2012

- **Belgium**

  National Kidney Preservation Service for ECD and DCD kidneys since 2022 using continuous non oxygenated and oxygenated (for donors >50y) HMP

All reported reduced DGF and organ discard rates

Proposal

- **A northern network for continuous oxygenated HMP**
- As a feasibility model and precursor to national rollout

- Abdominal NORS teams
  - Leeds
  - Manchester
  - Newcastle
  - Edinburgh

- Kidney transplant centres
  - Leeds
  - Liverpool
  - Manchester
  - Newcastle
  - Sheffield
  - Edinburgh
  - Glasgow

Proposal

Hub ops

- Abdominal NORS teams
  - Leeds (38w)
  - Manchester (38w)
  - Newcastle (52w)
  - Edinburgh (52w)

- Kidney transplant centres
  - Leeds
  - Liverpool
  - Manchester
  - Newcastle
  - Sheffield
  - Edinburgh
  - Glasgow

Donor hospital

Potential impact

- Northern NORS teams cover 28% of donors (37.3% with Edinburgh)
- Total kidneys retrieved in 2023/2024: 2864 (30% from northern teams; 39% with Edinburgh)*

With a northern network, a **30-40%** provision of continuous HMP is estimated (of total deceased donor kidney transplants)

- Out of 248 episodes of estimated DGF occurrences in kidney transplants in the northern centres last year, 69 may have been prevented with continuous HMP
- Potential further impact on long-term graft function, organ utilisation and national rollout

*Note 11% of kidneys from proceeding DCD donors undergo NRP

Requirements

Agreement in principle between NORS centres and implanting centres

NHSBT approval

Funding

Training for HMP delivery

Challenges

- Governance framework
  - Organ damage (benchwork/transit)
  - Infection risk
  - Potential for error if only one kidney is being perfused
- Logistics and communication
  - Transport and storage
  - Tracking of pumps
  - Perceived additional time/effort required
  - Restocking consumables based on demand
  - Direct communication between surgeons may inadvertently bypass SNODs, hub ops and coordinators
- Funding
  - Capital and maintenance (charity funding; existing equipment/agreements; new investment; incentivised schemes, loaner programmes … etc)
  - Circuits and transport (will need to be funded by recipient centres)

Costing model

- XVIVO Machine – £46,350 (BOGOF if 4 purchased)
- Perfusion sets - £2,642 (8% discount if >100 per year)
- Portable oxygen cylinder - £103 (can be used for up to 24hr of perfusion)

- Costs of HMP should be balanced against the costs of DGF*
- Dialysis – average 5 sessions (£213-£223 per HD session)
- Prolonged hospital stay
  - DCD kidney average inpatient cost (excluding surgery):
    Short stay - £10,388
    Long stay - £22,959 (£12,571 difference on average)

*Data source: NHS England - 2023/24 National Cost Collection data

Thank you