Chronic renal histological changes at implantation and subsequent deceased donor kidney transplant outcomes: a single-centre analysis

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Introduction

• UK deceased kidney donors have changed significantly over the last decade

• Increasing utilisation of older donors

• More kidneys from ‘high risk’ donors

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**Age of deceased kidney donors in the UK**

<table>
<thead>
<tr>
<th>Year</th>
<th>0-17</th>
<th>18-49</th>
<th>50-59</th>
<th>60-69</th>
<th>70+</th>
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<tbody>
<tr>
<td>2007-2008</td>
<td>3</td>
<td>48</td>
<td>17</td>
<td>26</td>
<td>5</td>
</tr>
<tr>
<td>2008-2009</td>
<td>5</td>
<td>50</td>
<td>15</td>
<td>24</td>
<td>7</td>
</tr>
<tr>
<td>2009-2010</td>
<td>8</td>
<td>46</td>
<td>18</td>
<td>24</td>
<td>17</td>
</tr>
<tr>
<td>2010-2011</td>
<td>10</td>
<td>42</td>
<td>20</td>
<td>23</td>
<td>15</td>
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<tr>
<td>2011-2012</td>
<td>11</td>
<td>38</td>
<td>23</td>
<td>25</td>
<td>14</td>
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<tr>
<td>2012-2013</td>
<td>12</td>
<td>37</td>
<td>22</td>
<td>22</td>
<td>11</td>
</tr>
<tr>
<td>2013-2014</td>
<td>15</td>
<td>37</td>
<td>22</td>
<td>25</td>
<td>13</td>
</tr>
<tr>
<td>2015-2016</td>
<td>13</td>
<td>36</td>
<td>13</td>
<td>22</td>
<td>14</td>
</tr>
<tr>
<td>2016-2017</td>
<td>14</td>
<td>36</td>
<td>14</td>
<td>22</td>
<td>14</td>
</tr>
</tbody>
</table>

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Annual report on kidney transplantation 2016/2017, NHSBT
Introduction

- UK deceased kidney donors have changed significantly over the last decade
  - Increasing utilisation of older donors
  - More kidneys from ‘high risk’ donors

![UK Kidney Donor Risk Index of DBD donor kidney transplants](image)
Introduction

• More accurate donor risk assessment tools are needed to inform utilisation decisions and to enable appropriate recipient selection

Registry-based donor risk indices

• UKKDRI – Watson et al, *Transplantation* 2012
• New UKKDRI – Mumford et al, *unpublished*
Introduction

• More accurate donor risk assessment tools are needed to inform utilisation decisions and to enable appropriate recipient selection

Chronic changes on kidney biopsy

• Karpinski — Karpinski et al, *Transplantation* 1999
• CADI — Nyberg et al, *Transplant* 2001
• Banff — Liapis et al, *Am J Transplant* 2017
Utility of pre-implantation kidney biopsy?

Baseline Donor Chronic Renal Injury Confers the Same Transplant Survival Disadvantage for DCD and DBD Kidneys

V. Kosmoliaptis², M. Sali³, V. Bardsley², Y. Chen², S. Thiru², M. H. Griffiths², H. C. Copley¹, K. Saeb-Parry¹, J. A. Bradley¹, N. Torpey¹ and G. J. Pettigrew¹

Evaluation of pre-implantation kidney biopsies: Comparison of Banff criteria to a morphometric approach

José António Lopes, Francesc Moreno, Lluís Riera, Marta Carrera,Meritxell Ibernon, Xavier Fulladura, Josep Maria Grinyó, and Daniel Serón

Chronic Histological Damage in Early Indication Biopsies Is an Independent Risk Factor for Late Renal Allograft Failure

M. Næsensᵃᵇᶜ, D. R. J. Kuypersᵃᵇᶜ, K. De Vusserᵃᵇᶜ, Y. Vanrenterghemᵃᵇᶜ, P. Evenepoelᵃᵇᶜ, K. Claesᵃᵇᶜ, B. Bammensᵃᵇᶜ, B. Meijersᵃᵇᶜ and E. Lerut¹

Received 15 May 2012, revised 15 August 2012 and accepted for publication 30 August 2012
Aims

1. Determine whether chronic donor histological changes at transplantation were predictive of graft outcomes at our centre. If so, what histological score thresholds can be used to determine optimal organ selection?

2. Determine whether systematic pre-implantation kidney biopsies would have increased organ utilisation.
Methods

1. DATA
2. INCLUSION CRITERIA
3. HISTOPATHOLOGY
4. GROUPS
5. OUTCOMES
6. STATISTICS
7. UTILISATION ANALYSIS

- Retrospective analysis
- Single-centre
- Follow-up period: 5 years or 20 January 2018
Methods

- Deceased donor: DBD & DCD
- Single kidney-only transplants
- Adult recipients
Methods

- Biopsies taken on the day of transplantation
- 16G core biopsy: formalin fixed, paraffin embedded
- Staining: H&E, PAS, PAMS and Masson trichrome
- Karpinski (K) score by renal histopathologists
  - Scored 0-12 (≥20 glomeruli)
  - Based on glomerular, tubular, interstitial and vascular components (each 0-3)
- K score not known at the time of transplantation
Methods

DATA

INCLUSION CRITERIA

HISTOPATHOLOGY

GROUPS

OUTCOMES

STATISTICS

UTILISATION

ANALYSIS

Compare low vs high K score at two thresholds

- K score 0-3 vs 4-12
- K score 0-4 vs 5-12
Methods

- Graft function (4-variable MDRD eGFR)
- Death-censored graft survival (DCGS)
- Patient survival
Methods

DATA

INCLUSION CRITERIA

HISTOPATHOLOGY

GROUPS

OUTCOMES

STATISTICS

UTILISATION ANALYSIS

Normality
- Shapiro-Wilk
- Q-Q plots

Demographic comparisons
- Student T test
- Mann-Whitney test
- $\chi^2$ test

Correlation analysis
- Spearman’s rho

Kaplan Meier survival
- Log rank

Multivariate analysis
- Linear regression
- Cox regression
Methods

- Examine organ utilisation at our centre
  - 2012-2015, DBD and DCD, donors 60+ years
  - Single and dual transplants, adult recipients
  - Retrospectively determine organ utilisation had we known the kidney biopsy result pre-operatively, using 0-4 / 5-6 / 7+ thresholds
Results

All single adult kidney-only transplants 2005-2015  
\( n = 844 \)

Time zero kidney biopsy performed  
\( n = 588 \) (70%)

Adequate biopsy  
(≥20 glomeruli)  
\( n = 408 \) (69%)

No biopsy  
\( n = 256 \) (30%)

Inadequate biopsy  
(<20 glomeruli)  
\( n = 180 \) (31%)
## Results: donor / recipient groups

<table>
<thead>
<tr>
<th>DONOR characteristics</th>
<th>Adequate biopsy (n=408)</th>
<th>No or inadequate biopsy (n=436)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Donor age (years)</strong></td>
<td>51 (41-60)</td>
<td>50 (43-64)</td>
<td>0.38</td>
</tr>
<tr>
<td><strong>Donor gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>210 (51.5%)</td>
<td>222 (50.9%)</td>
<td>0.87</td>
</tr>
<tr>
<td>Female</td>
<td>198 (48.5%)</td>
<td>214 (49.1%)</td>
<td></td>
</tr>
<tr>
<td><strong>Donor type</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DBD</td>
<td>274 (67.2%)</td>
<td>292 (67.0%)</td>
<td>0.96</td>
</tr>
<tr>
<td>DCD</td>
<td>134 (32.8%)</td>
<td>144 (33.0%)</td>
<td></td>
</tr>
<tr>
<td><strong>Cause of death</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stroke</td>
<td>241 (59.1%)</td>
<td>241 (55.3%)</td>
<td>0.32</td>
</tr>
<tr>
<td>Trauma</td>
<td>40 (9.8%)</td>
<td>38 (8.7%)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>127 (31.1%)</td>
<td>157 (36%)</td>
<td></td>
</tr>
<tr>
<td><strong>UKKDRI</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤1.35</td>
<td>261 (65.6%)</td>
<td>227 (62.4%)</td>
<td>0.22</td>
</tr>
<tr>
<td>&gt;1.35 (high risk)</td>
<td>137 (34.4%)</td>
<td>137 (37.6%)</td>
<td>0.36</td>
</tr>
<tr>
<td><strong>Cold ischaemia time (mins)</strong></td>
<td>840 (660-1027)</td>
<td>900 (690-1050)</td>
<td>0.46</td>
</tr>
</tbody>
</table>

Data are expressed as number (%), median (IQR)

<table>
<thead>
<tr>
<th>RECIPIENT characteristics</th>
<th>Adequate biopsy (n=408)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Recipient age (years)</strong></td>
<td>50 (42-59)</td>
</tr>
<tr>
<td><strong>Recipient gender</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>258 (63.2%)</td>
</tr>
<tr>
<td>Female</td>
<td>150 (36.8%)</td>
</tr>
<tr>
<td><strong>Recipient ethnicity</strong></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>232 (56.9%)</td>
</tr>
<tr>
<td>Black</td>
<td>124 (30.4%)</td>
</tr>
<tr>
<td>Other</td>
<td>52 (12.7%)</td>
</tr>
<tr>
<td><strong>Primary renal disease</strong></td>
<td></td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>41 (10.0%)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>73 (17.9%)</td>
</tr>
<tr>
<td>Other</td>
<td>294 (72.1%)</td>
</tr>
<tr>
<td><strong>Graft number</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>344 (84.3%)</td>
</tr>
<tr>
<td>&gt;1</td>
<td>64 (15.7%)</td>
</tr>
<tr>
<td><strong>HLA mismatch level</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>55 (14%)</td>
</tr>
<tr>
<td>2</td>
<td>130 (33%)</td>
</tr>
<tr>
<td>3</td>
<td>188 (47%)</td>
</tr>
<tr>
<td>4</td>
<td>26 (6%)</td>
</tr>
</tbody>
</table>
Results: K score distribution

Histogram of K score distribution

Donor age versus K score

Spearman’s rho = + 0.54
p < 0.001
Results: K score and graft function (1)

<table>
<thead>
<tr>
<th></th>
<th>K score ≤ 4</th>
<th>K score ≥ 5</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 year eGFR (n=370)</td>
<td>52 (38-66)</td>
<td>41 (32-54)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>3 year eGFR (n=256)</td>
<td>53 (45-67)</td>
<td>46 (33-58)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>5 year eGFR (n=141)</td>
<td>51 (37-63)</td>
<td>45 (34-66)</td>
<td>0.35</td>
</tr>
</tbody>
</table>

Data are expressed as median (IQR), mL/min/1.73m²
Graft failures excluded

1 year eGFR versus K score

Spearman’s rho = -0.3 (p < 0.001)
Weak association
Results: K score and graft function (2)

Linear regression analysis

Covariates in the equation

- K score
- Donor age
- UKKDRI
- Recipient age
- Graft number
- Transplant type (DBD/DCD)
- Cold ischaemia time
- HLA mismatch level

Predictors of lower graft function at 1 year

- For each K score increment → eGFR drops by 3 mL/min/1.73m² (p = 0.02)
- For each UKKDRI increase by 0.1 → eGFR drops by 1.5 mL/min/1.73m² (p < 0.001)

These effects were replicated at 3 years
Results: K score and graft survival (1)

Kaplan-Meier survival of DCGS stratified by K score

Log rank $p = 0.72$

No significant difference
Results: K score and graft survival (2)

Histogram of K score distribution

K score ≤ 3 vs ≥ 4

<table>
<thead>
<tr>
<th></th>
<th>K score ≤ 3</th>
<th>K score ≥ 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>p value</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Donor age (years)</td>
<td>44 (30-53)</td>
<td>57 (49-63)</td>
</tr>
<tr>
<td>Donor male gender</td>
<td>99 (53%)</td>
<td>111 (53%)</td>
</tr>
<tr>
<td>Donor cause of death</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stroke</td>
<td>100 (53%)</td>
<td>141 (64%)</td>
</tr>
<tr>
<td>Trauma</td>
<td>29 (15%)</td>
<td>11 (5%)</td>
</tr>
<tr>
<td>UKKDRI</td>
<td>1.01 (0.80-1.09)</td>
<td>1.34 (1.01-1.54)</td>
</tr>
<tr>
<td>Recipient age (yr)</td>
<td>48 (41-57)</td>
<td>52 (44-62)</td>
</tr>
<tr>
<td>Recipient male gender</td>
<td>116 (62%)</td>
<td>142 (65%)</td>
</tr>
<tr>
<td>Cold ischaemia time (min)</td>
<td>804 (649-1005)</td>
<td>843 (529-1028)</td>
</tr>
</tbody>
</table>

Log rank p = 0.26
No significant difference
Results: K score and graft survival (3)

Log rank p = 0.14
No significant difference

<table>
<thead>
<tr>
<th></th>
<th>K score ≤ 4</th>
<th>K score ≥ 5</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Donor age (yr)</td>
<td>49 (35-57)</td>
<td>58 (50-66)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Donor male gender</td>
<td>143 (51%)</td>
<td>67 (52%)</td>
<td>0.92</td>
</tr>
<tr>
<td>Donor cause of death</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stroke</td>
<td>115 (41%)</td>
<td>86 (67%)</td>
<td>0.73</td>
</tr>
<tr>
<td>Trauma</td>
<td>32 (11%)</td>
<td>8 (6%)</td>
<td>0.73</td>
</tr>
<tr>
<td>UKKDRI</td>
<td>1.02 (0.83-1.28)</td>
<td>1.39 (1.01-1.85)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Recipient age (yr)</td>
<td>49 (40-58)</td>
<td>54 (46-63)</td>
<td>0.005</td>
</tr>
<tr>
<td>Recipient male gender</td>
<td></td>
<td></td>
<td>0.02</td>
</tr>
<tr>
<td>Cold ischaemia time (min)</td>
<td>810 (641-1020)</td>
<td>866 (643-1011)</td>
<td>0.48</td>
</tr>
</tbody>
</table>
Results: K score and graft survival (4)

<table>
<thead>
<tr>
<th>K score component</th>
<th>Association with death censored graft survival?</th>
<th>p value</th>
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</thead>
<tbody>
<tr>
<td>Interstitial</td>
<td>✗</td>
<td>0.31</td>
</tr>
<tr>
<td>Tubular</td>
<td>✗</td>
<td>0.33</td>
</tr>
<tr>
<td>Glomerular</td>
<td>✗</td>
<td>0.78</td>
</tr>
<tr>
<td>Vascular</td>
<td>✗</td>
<td>0.31</td>
</tr>
</tbody>
</table>
Results: K score and graft survival (5)

Donors aged 50+ years

Log rank p = 0.89
No significant difference

Log rank p = 0.27
No significant difference

Donors aged 60+ years

Log rank p = 0.55
No significant difference

Log rank p = 0.24
No significant difference
Results: predictors of DCGS

Cox regression analysis

Covariates in the equation

- K score
- Donor age
- UKKDRI
- Recipient age
- Graft number
- Transplant type (DBD/DCD)
- Cold ischaemia time
- HLA mismatch level

Independent predictors of DCGS

K score does not predict DCGS (p = 0.60)

Graft number >1 only predictor of DCGS (p < 0.001)
Results: primary non-function (PNF)

- Does K score predict ‘PNF’?
  - ‘PNF’ defined as graft survival of zero days, regardless of cause

- Multivariate analysis:
  - K score ≥ 5 is an independent predictor of ‘PNF’ (HR 3.5, p = 0.04)
Results: patient survival

Patient survival stratified by K score $\leq 3$ vs $\geq 4$

- Log rank $p = 0.64$
- No significant difference

Patient survival stratified by K score $\leq 4$ vs $\geq 5$

- Log rank $p = 0.25$
- No significant difference
Results: impact on organ utilisation

**Clinically acceptable kidneys**
- 2012 to 2015
- Donors ≥ 60 years
- Adequate ‘time zero’ biopsy

**Single**
- 73 kidneys
- 73 recipients
- Median 1 year eGFR 38
- 1 year DCGS 90%

**Dual**
- 40 kidneys
- 20 recipients
- Median 1 year eGFR 51
- 1 year DCGS 88%

**TOTAL**
- 113 kidneys
- 93 recipients

**Utilisation algorithm**
- **Single kidney transplant(s)?**
  - One kidney at our centre?
    - K score 0-4 → SINGLE
    - K score 5+ → DECLINE
  - Both kidneys at our centre?
    - Both K scores 0-4 → SINGLE
    - Highest K score 5-6 → DUAL
    - Highest K score 7-12 → DECLINE
- **Dual kidney transplant?**
  - Both K scores 0-4 → SINGLE x 2
  - Highest K score 5-6 → DUAL
  - Highest K score 7-12 → DECLINE

**Single**
- 54 kidneys
- 54 recipients

**Dual**
- 30 kidneys
- 15 recipients

**Decline**
- 29 kidneys

**TOTAL**
- 84 kidneys
- 69 recipients
Conclusions

• Kidneys with K scores 0 to 8 have been implanted as single grafts with good results

• For every increment in K score, there is a $3 \text{ mL/min/}1.73m^2$ drop in eGFR at 1- and 3-years

• There is no association between K score and medium-term DCGS
  • Independent predictor of primary non-function

• Retrospective application of a clinico-pathological tool to our programme suggests that organ utilisation would have decreased

• These data do not support the widespread use of PIKB in our deceased donor kidney programme, given our current donor risk profile
Acknowledgments

• Surgical colleagues
  o Geoff Koffman, John Taylor, Francis Calder, Nizam Mamode, Jonathon Olsburgh, Martin Drage, Ioannis Loukopoulos, Nikolaos Karydis

• Histopathology colleagues
  o Patrick O’Donnell, Fahim Tungekar, Robert Hangartner, Ran Perera

• Patrick Trotter, NHS Blood and Transplant
• Donors, recipients, and their families
Appendix 1: DCGS in high UKKDRI donors

DCGS in patients with UKKDRI ≥ 1.35

DCGS in patients with UKKDRI ≥ 1.50

Survival

Time post-transplant (days)
Appendix 2: K score and graft function

3 year eGFR according to K score

Spearman’s rho = -0.3 (p<0.001)
Weak association

5 year eGFR according to K score

No correlation
Appendix 3: donor and recipient age match
Appendix 4: DSGS at Guy’s (registry data)

First graft survival post-transplantation, 2006-2010

≈87%

First graft survival post-transplantation, 2011-2016

≈88%
Appendix 5 – Biopsy adequacy rates

<table>
<thead>
<tr>
<th></th>
<th>Punch biopsy</th>
<th>16G Core biopsy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of values</strong></td>
<td>16</td>
<td>576</td>
</tr>
<tr>
<td><strong>Minimum</strong></td>
<td>28</td>
<td>0</td>
</tr>
<tr>
<td><strong>25% Percentile</strong></td>
<td>35.25</td>
<td>17</td>
</tr>
<tr>
<td><strong>Median</strong></td>
<td>42</td>
<td>25</td>
</tr>
<tr>
<td><strong>75% Percentile</strong></td>
<td>45.25</td>
<td>35</td>
</tr>
<tr>
<td><strong>Maximum</strong></td>
<td>65</td>
<td>97</td>
</tr>
</tbody>
</table>

- **Shipiro-Wilk test of normality**: Non-parametric
- **Mann-Whitney test comparing both medians**: \( p = <0.001 \)
- **Fisher’s exact test comparing adequacy**: \( p = 0.005 \)

![Number of glomeruli: punch vs core biopsy](image-url)
Appendix 6: Time-zerO Biopsy Investigators (TOBI)

- National, multi-centre, retrospective analysis of biopsies of deceased donor kidneys
  - Re-analysis of time-zero or pre-implantation kidney biopsies 1.1.08-1.1.16 by multiple blinded renal pathologists
  - Linkage to the national transplant registry to capture donor / recipient variables and determine patient outcomes
  - Aims:
    1) determine association between chronic changes at the time of transplantation and subsequent graft and patient outcomes
    2) determine the most accurate histological and/or clinico-histopathological scoring systems
    3) better define inter-observer variability between renal pathologists

- Group
  - Chris Callaghan, transplant surgeon, London
  - Candice Roufosse, pathologist, London
  - Rachel Johnson, statistician, NHSBT
  - Desley Neil, pathologist, Birmingham
  - Gavin Pettigrew, transplant surgeon, Cambridge
  - Rachel Hilton, nephrologist, London

- Next steps
  - Combination of Guy’s and Cambridge databases and re-analysis via the national transplant registry
  - Exchange historical slides between Guy’s and Cambridge renal histopathologists for blinded scoring
  - Broaden TOBI group and invite interested UK renal transplant centres to join
  - Funding application (NIHR RfPB)
Appendix 7: Graft survival: DBD vs DCD

- 274 DBDs vs.134 DCDs
- Overall, DCGS was the same between DBDs and DCDs (p=0.99)
- No association between K score and DCGS in DCDs (p=0.50)
- Association between K score and DCGS in DBDs (p=0.02)
  - Association lost if PNF patients removed

Log rank p = 0.50
No significant difference

Log rank p = 0.02
K score ≥ 5 associated with DCGS in DBDs
Appendix 8: Graft survival: DBD vs DCD

- 274 DBDs vs. 134 DCDs
- Overall, DCGS was the same between DBDs and DCDs (p=0.99)
- No association between K score and DCGS in DCDs (p=0.50)
- Association between K score and DCGS in DBDs (p=0.02)
  - Association lost if PNF patients removed

Log rank p = 0.33
No significant difference

Log rank p = 0.23
No significant difference
The graph shows the percentage of kidneys biopsied from 2006 to 2014. Initially, the percentage was low, but there was a significant increase around 2008 to 2009. After 2009, the percentage stabilized at around 80%. There was a slight decrease around 2012 followed by a slight increase in 2014.
Clinically acceptable kidneys

- 2012 to 2015
- Donors ≥ 60 years
- Adequate ‘time zero’ biopsy

Single
73 kidneys
73 recipients

Median 1 year eGFR 38 mL/min/1.73m²
1 year DCGS 90%

Dual
40 kidneys
20 recipients

Median 1 year eGFR 51 mL/min/1.73m²
1 year DCGS 88%

TOTAL
113 kidneys
93 recipients

Results: impact on organ utilisation

Utilisation algorithm

- Single kidney transplant(s)?
  - One kidney at our centre?
    - K score 0-4 → SINGLE
    - K score 5+ → DECLINE
  - Both kidneys at our centre?
    - Both K scores 0-4 → SINGLE
    - Highest K score 5-6 → DUAL
    - Highest K score 7-12 → DECLINE

- Dual kidney transplant?
  - Both K scores 0-4 → SINGLE x 2
  - Highest K score 5-6 → DUAL
  - Highest K score 7-12 → DECLINE

Single
54 kidneys
54 recipients

Median 1 year eGFR 43 mL/min/1.73m²
1 year DCGS 90% (n=30)

Dual
30 kidneys
15 recipients

Median 1 year eGFR 51 mL/min/1.73m²
1 year DCGS 75% (n=8)

Decline
29 kidneys

TOTAL
84 kidneys
69 recipients

Median 1 year eGFR 43 mL/min/1.73m²
1 year DCGS 90%