The Evaluation of Kidney Transplant Candidates and Potential Living Donors

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Case #1

- 37 yo male, ESRD due to FSGS
- Living-related kidney transplant age 17, deceased donor transplant age 22, and living-related kidney transplant age 27
- Back on dialysis in 2002, wants another transplant
- Recurrent FSGS 1st and 3rd transplants
- Is he a candidate? Living donor or DD?
Case #2

- 71 year old male, ESRD due to HTN, on dialysis since 2000
- Retired social worker, very compliant, very active person
- H/o colon cancer 7 years ago
- Routine blood work: PSA 8.1
- Is he a candidate?
- Can we transplant him now?
Case #3

- 30 year old male, ESRD due to lithium toxicity, not on dialysis yet
- H/o bipolar disorder, lives with his parents (mother 68 yo, father 72 yo)
- Psychosis if he stops lithium, has learning disabilities
- He also has severe peripheral neuropathy (Charcot-Marie-Tooth’s), uses a wheel chair
- Is he a candidate?
Case #4

- 48 yo woman, ESRD due to IgA nephropathy, on dialysis
- H/o breast cancer treated with surgery and radiation 16 months ago
- Her sister wants to donate a kidney to her (6 antigen match), family wants surgery in 1 month
- Can we transplant her now?
Case #5

- 31 year old woman, ESRD due to lupus
- Started dialysis 2 years ago
- Hospital admission 2 months ago for pericardial effusion and anemia, now has weight loss
- ANA: 1:320, anti-DNA: 1:1280, C3: 10, C4: 18
- She has 3 potential living donors
- Can we transplant her now?
Recipient Evaluation

- Kidney transplantation is THE treatment of choice for patients with ESRD
- Waiting time: long, average 3 years
- Patients and their families should be well informed concerning the procedure as well as immunosuppression
- Informed decision and active participant
Recipient Evaluation

• Referral for transplant-nephrologists (majority) or self-referral (rare)
• Basic information gathering: insurance coverage, patient’s medical history, family history (including potential living donors) and laboratory results
• Initial interview and exam
Recipient Evaluation

• Physical exam
• Chest x-ray, ECG-12 lead
• Dental evaluation*
• Pap smear, mammogram
• Labs: CMP, CBC, serologies (HIV, hepatitis B and C, CMV, and RPR), HLA typing, PRA, PSA
Recipient Evaluation

- Stress test (dobutamine echo or thallium)
- Colonoscopy
- Arterial Doppler of carotids or lower extremities
- MRI abdomen/MRA of pelvis
- Toxicology screen
- Echocardiogram
- Pulmonary function test
Physical Exam

- Dental health
- Carotid pulse/bruit
- Peripheral pulses, abdominal and femoral bruit
- Careful abdominal exam: previous surgeries/scars, organomegaly, large kidneys in patients with PKD
- Testicular exam, rectal exam
- Breast exam
Medical History

• Recent diagnosis of cancer
• Active infection (catheter-related, endocarditis, osteomyelitis, etc.)
• Recent chest pain, MI, or arrhythmias
• Foot ulcers, GI bleeding
• Malnutrition, morbid obesity
Medical History-Cancer

- Active or recent evidence of a malignancy, except for some skin cancer (basal cell): transplant is contraindicated
- Israel Penn International Transplant Tumor Registry (IPITTR)
- Waiting time: varies amongst different tumors
  *Breast Ca*: at least 2 years-up to 5 years in certain tumors (regional lymph node involvement, bilateral disease, inflammatory histopathology)
## Recurrence Risk of Pre-existing Breast Cancer After Solid Organ Transplantation

<table>
<thead>
<tr>
<th>Wait time</th>
<th>&lt;2 yrs</th>
<th>2-5 yrs</th>
<th>&gt;5 yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td># Patients</td>
<td>10</td>
<td>30</td>
<td>51</td>
</tr>
<tr>
<td>% Recurrence</td>
<td>20</td>
<td>20</td>
<td>9.8</td>
</tr>
<tr>
<td>Died of disease</td>
<td>10</td>
<td>17</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stage</th>
<th>Stage I (55)</th>
<th>Stage II (25)</th>
<th>Stage III (11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median wait (mo)</td>
<td>65.3</td>
<td>87.2</td>
<td>61.5</td>
</tr>
<tr>
<td>% Recurrence</td>
<td>5.4</td>
<td>8</td>
<td>63.6</td>
</tr>
<tr>
<td>% Died of disease</td>
<td>3.6</td>
<td>4</td>
<td>45</td>
</tr>
<tr>
<td>Survival (1,3,5 yrs)</td>
<td>95, 87, 73%</td>
<td>95, 88, 88%</td>
<td>100, 67, 14%</td>
</tr>
</tbody>
</table>

- High mortality with less than 5-year waiting period
- No transplantation in stage III breast cancer patients

*Buell JF et al, abstract #518, AST 2003*
## Risk of Post-Transplant Recurrence of Pre-Existing Malignancies

<table>
<thead>
<tr>
<th>Risk group</th>
<th>Tumor type</th>
<th>Patients (n)</th>
<th>Patients treated &gt;5 years prior to transplantation (%)</th>
<th>Overall Recurrence Risk (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Incidental RCC(^1)</td>
<td>72</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Uterine</td>
<td>26</td>
<td>50</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Testicular</td>
<td>43</td>
<td>58</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Cervical</td>
<td>93</td>
<td>54</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Thyroid</td>
<td>54</td>
<td>38</td>
<td>7</td>
</tr>
<tr>
<td>Moderate</td>
<td>Lymphoma</td>
<td>37</td>
<td>76</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Wilm’s</td>
<td>78</td>
<td>33</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Prostate</td>
<td>33</td>
<td>34</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Colon</td>
<td>53</td>
<td>42</td>
<td>21</td>
</tr>
<tr>
<td>High</td>
<td>Breast</td>
<td>90</td>
<td>51</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>Symptomatic RCC</td>
<td>222</td>
<td>22</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Bladder</td>
<td>55</td>
<td>22</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>Sarcoma</td>
<td>17</td>
<td>24</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>Skin</td>
<td>125</td>
<td>11</td>
<td>53</td>
</tr>
</tbody>
</table>

\(^1\)Refers only to tumors incidentally discovered at time of bilateral nephrectomy pre- or concurrent with renal transplantation.

Case #4

- 48 yo woman, ESRD due to IgA nephropathy, on dialysis
- H/o breast cancer treated with surgery and radiation 16 months ago
- Her sister is the donor (6 Ag match), family wants surgery in 1 month
- Waiting time: 5 years
Medical History - Cancer

- **Prostate Ca**: At least 2 years disease-free period followed by negative blind random biopsies
- **Renal cell Ca**: 2-year waiting time for asymptomatic >2 cm RCC, possibly shorter time <2 cm, at least 5 years for symptomatic RCC (recurrence risk is still ~26%)
- **Colorectal Ca**: waiting period of 5 years for all Duke’s classifications
Case #2

- 71 year old male, ESRD due to HTN, on dialysis since 2000
- Retired social worker, very compliant, very active person
- H/o colon cancer 7 years ago: Waiting time at least 5 yrs, Duke A or B1 could have shorter waiting time
- Routine blood work: PSA 8.1: biopsy: not cancer; if cancer, waiting time at least 2 years
Medical History-Infection-HIV

- Undetectable plasma HIV-1 RNA levels (viral load) for at least 3 months (kidney)
- CD4+ T-cell count of more than 200 cells/microL
- No history of opportunistic infections and neoplasms
- Maintained on highly active antiretroviral therapy (HAART)
- Increased incidence of acute rejection after transplantation
- Preliminary data are encouraging
Medical History-Infection Hepatitis C

• After transplantation, liver disease is more frequent in HCV-positive patients than in HCV-negative patients
• HCV-positive patients have a higher risk for developing proteinuria, diabetes and infections after transplantation
• Long-term patient and graft survival rates are lower in HCV-positive patients than in HCV-negative graft recipients
Medical History-Infection
Hepatitis C

- Mortality is higher, mainly as a result of liver disease and infections
- HCV-positive renal transplant recipients had a better survival than similar HCV-positive patients awaiting transplantation

Medical History-Infection
Hepatitis C

- All transplant candidates should be tested for HCV
- Serum transaminases may be normal even if the patient has advanced liver disease
- If HCV RNA is positive, proceed with liver biopsy
- Cirrhosis—consider combined liver/kidney transplant
- HCV is not a contraindication for transplant
Medical History-Infection
Tuberculosis (TB)

• The prevalence of TB in renal transplant recipients 0.4-1.7% in the US and up to 12% in developing countries
• Aggressive disease with dissemination
• Chest x-ray, PPD, h/o therapy (how long and which medication?)
• INH prophylaxis for at least 6 months in patients with +PPD, past history of TB, in patients from high-risk populations
Medical History - Cardiovascular Risks

Mortality of transplant recipients from cardiovascular disease is 25 times higher than age/sex matched general population.

- Age, ESRD
- Hypertension
- Hyperlipidemia
- Diabetes
- Smoking
- Obesity
Cardiovascular Disease

- Pre-transplant CVD important risk factor for post-transplant CVD
- High risk patients (diabetics, older patients, patients with 2 or more risk factors) should have a cardiac stress test/cardiac cath before transplant
- Repeat screening 1-2 years during waiting, every year for diabetics
Heart Disease-Evaluation

- 151 patients with IDDM, candidates for kidney transplantation without any chest pain, at University of Minnesota
- Routine arteriogram as part of the protocol
- 31 patients had significant stenosis
- 26/31 were randomized either to revascularization or medical treatment

Heart Disease-Evaluation

- 10/13 medically managed and 2/13 revascularized patients had a cardiovascular end-point 8.4 months (median) after arteriogram
- Revascularization decreased the frequency of cardiac events in this patient population
- **Conclusion**: Diabetic renal transplant candidates should be screened for silent CAD before transplantation

Screening Diabetic Transplant Candidates for CAD

- Coronary angiography is recommended:
  - All Caucasian type I diabetics over age 45
  - Type I diabetics younger than age 45 with EKG changes (ST-T segment), smoking history (>5 pack/year), diabetes for at least 25 years

Sensitivity: 97%, negative predictive value: 96%

*Manske CL et al, Kidney Int 44:617-621, 1993*
Screening Asymptomatic Diabetic Patients for CAD

- 97 asymptomatic type 1 and 2 DM kidney and kidney-pancreas transplant candidates
- 33% of type 1 and 48% of type 2 DM patients had significant stenosis (> or = 70%) in 1 or more coronary arteries
- On multivariate logistic regression analysis, BMI >25 was significantly associated with CAD (relative risk = 4.8, P = 0.002), also age of the patient, and smoking history
- Young African American DM patients with no smoking history and a BMI <=25 are at reduced risk, and invasive tests may not be necessary in this group

*Ramanathan V, Goral S, Transplantation 2005*
Obesity and Transplantation

- The majority (60%) of subjects at time of transplantation currently are overweight or obese
- Between 1987 and 2001, the proportion of obese transplant recipients rose by 116% (grossly similar to that in the general population)
- The likelihood of being obese increased with age, female sex, NIDDM, black race, and the more recent the transplant year

Friedman AN et al, Am J Kidney Dis 2003
Obesity and Transplantation

- 493 patients from Australia, 59 (12%) were obese (BMI 30 kg/m)
- More superficial wound breakdown (14% vs. 4%, P<0.01), complete wound dehiscence (3% vs. 0%, P<0.01), and wound infections (15% vs. 8%, P=0.11)
- Similar graft survival and patient survival

Johnson DW et al, Transplantation 2002
Obesity and Transplantation

- Analysis of paired kidneys: obesity (BMI > 30) is not a risk factor for DGF, acute rejection, and 1-year graft survival, but decreased long-term graft survival
  
  Yamamoto S et al, Clin Transplant 2002

- Obese transplant (BMI > 35) recipients have similar outcomes to nonobese patients, more posttransplant DM
  
  Howard RJ et al, Transplantation 2002

- Obese children (6-12 years) higher risk for death than nonobese patients due to cardiopulmonary disease (27% in obese vs 17% in nonobese). Graft loss as a result of thrombosis more common in obese as compared with nonobese (19% vs 10%)
  
  Hanevold CD et al, Pediatrics 2005
Obesity and Transplant Outcome

- UNOS database: 27,377 primary kidney-only transplants between 1997 and 1999
- Morbid obesity (BMI ≥ 35) was independently associated with increased risk of:
  - DGF (p < 0.001)
  - Prolonged hospitalization (p < 0.001)
  - Acute rejection (p = 0.006)
  - Decreased overall graft survival (p = 0.001)

Medical History - Other Risks

- Disease activity (lupus, vasculitis)
- Urologic disease, cystic disease
- Pre-transplant native kidney nephrectomy
- GI diseases (peptic ulcer, gallstones, pancreatitis)
- Medications (interactions)
- Psychosocial issues, alcohol and substance abuse
- Recurrent diseases (FSGS, MPGN, HUS, lupus)
- Ethical issues (noncompliance with meds, multiple transplants, transplant after recurrence)
Live Donor Evaluation
Living Donors

- The annual number of available deceased donors will not resolve the ongoing shortage of organs.
- The survival of a kidney transplanted from a live donor exceeds the results achieved from a deceased donor.
- Success of live donor transplantation no longer necessitates the consideration of an HLA match unless there is possibility of a transplant from HLA identical sibling.
- The survival rate of a kidney transplant from a genetically unrelated donor is excellent.
Living Donors

• In 1954: Requiring an identical twin for success
• During the 1980’s: Selection of an HLA-matched family member
• Current: any person (irrespective of the HLA match) can be a donor if they are medically and psychosocially suitable
Potential Live Donor Should Be:

- Competent, willing to donate
- Free of coercion
- Medically and psychosocially suitable
- Fully informed of the risks and benefits as a donor
- Fully informed of risks, benefits, and alternative treatment available to the recipient
Potential Advantages of Live Donation

• Better short-term and long-term results
• More consistent early function and ease of management
• Avoidance of long wait for cadaveric transplant
• Less delayed graft function
• Less aggressive immunosuppressive regimens
• Surgery can be planned ahead (medical and personal convenience)
• Emotional gain to donor
• Helps relieve stress on national cadaver donor supply
Potential Disadvantages of Live Donation

- Psychological stress to donor and family
- Inconvenience and risk of evaluation process (i.e. IV contrast)
- Operative mortality (0.03% or 1 in 2000 patients)
- Major perioperative complications (4.4%, range: 0.0 to 13.0%)
- Minor postoperative complications (up to 50%)
- Long-term morbidity
- Risk of traumatic injury to remaining kidney
- Risk for unrecognized chronic kidney disease
An International Survey

- Sent out by Donor Nephrectomy Outcome Research (DONOR) Network investigators
- 203 health practitioners from 119 cities in 35 different countries responded to the survey
- Sixty-three percent of respondents nephrologists, 27% surgeons, 4% nurse practitioners and 6% other individuals involved in discussing risks with potential donors

## Table 2. Long-term medical risks discussed with potential living kidney donors

<table>
<thead>
<tr>
<th>Risk Category</th>
<th>Proportion of health care providers&lt;sup&gt;a&lt;/sup&gt; with 95% confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>92 (87–95)%</td>
</tr>
<tr>
<td>Proteinuria</td>
<td>83 (77–87)%</td>
</tr>
<tr>
<td>Chronic kidney disease&lt;sup&gt;b&lt;/sup&gt;</td>
<td>81 (75–86)%</td>
</tr>
<tr>
<td>Kidney failure requiring dialysis</td>
<td>86 (81–90)%</td>
</tr>
<tr>
<td>Premature cardiovascular disease</td>
<td>33 (27–40)%</td>
</tr>
<tr>
<td>Premature death not related to the surgery</td>
<td>34 (28–41)%</td>
</tr>
</tbody>
</table>

<sup>a</sup> Survey of 203 transplant professionals (predominantly nephrologists and surgeons) who were responsible for informing potential donors of risks prior to donation.

<sup>b</sup> A glomerular filtration rate <60 ml/min.
Proportion of health care providers who believe the following medical risks are increased, compared to if a donor had elected not to have the nephrectomy

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Not increased</th>
<th>Increased</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood pressure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Higher systolic blood pressure than expected for age</td>
<td>44%</td>
<td>56%</td>
</tr>
<tr>
<td>Higher diastolic blood pressure than expected for age</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>Hypertension&lt;sup&gt;b&lt;/sup&gt;</td>
<td>55%</td>
<td>45%</td>
</tr>
<tr>
<td>Proteinuria</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Higher 24-h urine protein than expected for age</td>
<td>31%</td>
<td>69%</td>
</tr>
<tr>
<td>Higher 24-h urine albumin than expected for age</td>
<td>31%</td>
<td>69%</td>
</tr>
<tr>
<td>Microalbuminuria (30–300 mg/24 h)</td>
<td>27%</td>
<td>73%</td>
</tr>
<tr>
<td>Proteinuria (&gt;300 mg/24 h)</td>
<td>44%</td>
<td>56%</td>
</tr>
<tr>
<td>Reduced kidney function</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GFR 60–80 ml/min</td>
<td>21%</td>
<td>79%</td>
</tr>
<tr>
<td>GFR &lt; 60 ml/min</td>
<td>45%</td>
<td>55%</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiovascular disease</td>
<td>84%</td>
<td>16%</td>
</tr>
<tr>
<td>Death, not related to surgery</td>
<td>92%</td>
<td>8%</td>
</tr>
</tbody>
</table>

Long-Term Consequences of Live Kidney Donation

- Between 1973 and 2001, 152 living donor nephrectomies
- Seven of 152 donors had died from nonrenal diseases
- Of the remaining 145, data collection on 135 (93%) donors
- The mean time from nephrectomy to the current evaluation: $11 \pm 7$ (range 1–28) years

Table 3: Renal function before and after kidney donation, determined by different methods

<table>
<thead>
<tr>
<th></th>
<th>Before donation</th>
<th>At evaluation</th>
<th>p-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plasma creatinine (µmol/L)</td>
<td>72.5 ± 15.0†</td>
<td>85.7 ± 16.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Cystatin C (nmol/L)</td>
<td></td>
<td>67.4 ± 13.5</td>
<td></td>
</tr>
<tr>
<td>Cystatin C above normal (%)</td>
<td>23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measured creatinine clearance (mL/min/1.73 m²)</td>
<td>119 ± 30</td>
<td>99 ± 30</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Calculated GFR (MDRD 4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(mL/min/1.73 m²)</td>
<td>92 ± 20</td>
<td>71 ± 15</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

*Wilcoxon test.
†Mean ± SD.

**Table 4:** Blood pressure before and after kidney donation

<table>
<thead>
<tr>
<th></th>
<th>Before donation</th>
<th>At evaluation</th>
<th>p-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systolic blood pressure</td>
<td>125 ± 15†</td>
<td>134 ± 19</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>(mmHg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diastolic blood pressure</td>
<td>79 ± 11</td>
<td>81 ± 9</td>
<td>n.s.</td>
</tr>
<tr>
<td>(mmHg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertensive, %</td>
<td>7</td>
<td>30</td>
<td>&lt;0.001†</td>
</tr>
</tbody>
</table>

**Table 6:** Proteinuria in kidney donors

| Percentage with protein-excretion > 150 mg/day | 56 |
| Percentage with urinary albumin > 50 mg/L    | 10 |
| Percentage with urinary α1-microglobulin > 12 mg/L | 7  |
| Percentage with urinary IgG > 10 mg/L        | 2  |

Long-Term Consequences of Live Kidney Donation

• A decrease in creatinine-clearance or GFR by 20–25%, but no correlation between residual renal function and blood pressure or the amount of proteinuria in this cohort
• Blood pressure in these donors were slightly higher but it remained lower than in the normal population
• An increase in urinary protein excretion, but pathological albuminuria was rare

Long-term Morbidity

- Information on 464 live donors (60%)
- 20-37 years of follow-up
- 84 had died and 380 were alive; 3 in 84 had kidney failure; Of the 380 still alive, three had abnormal kidney function and two had undergone transplantation
- The rate of proteinuria and hypertension was similar to the age-matched general population

Ramcharan T et al, Am J Transplant 2002
Long-Term Morbidity

- 73 patients who had unilateral nephrectomy
- Normal kidney function, no proteinuria at the time of surgery
- Reasons for nephrectomy: stones in 29, renal mass in 14, hydronephrosis in 11, and renal tuberculosis in 5 patients
- Mean follow-up: 13.6± 8.6 years (18 months-35 years)
- 20 in 73 patients (27%) developed proteinuria/renal insufficiency

Table 1. Clinical characteristics of patients at the time of unilateral nephrectomy

<table>
<thead>
<tr>
<th></th>
<th>Total (N = 73)</th>
<th>Patients who maintained normal renal function (Group I) (N = 53)</th>
<th>Patients who later developed proteinuria/renal insufficiency (Group II) (N = 20)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age years</strong></td>
<td>39.7 ± 14.7</td>
<td>39 ± 14</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>(11–66)</td>
<td>(11–65)</td>
<td>41 ± 14</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td>35 M; 38 F</td>
<td>24 M; 29 F</td>
<td>NS</td>
</tr>
<tr>
<td><strong>Mean arterial pressure</strong></td>
<td>94 ± 12</td>
<td>93 ± 12</td>
<td>NS</td>
</tr>
<tr>
<td><strong>mm Hg</strong></td>
<td>(70–140)</td>
<td>(70–140)</td>
<td></td>
</tr>
<tr>
<td><strong>Serum creatinine</strong></td>
<td>1 ± 0.1</td>
<td>0.9 ± 0.1</td>
<td>NS</td>
</tr>
<tr>
<td>mg/dL</td>
<td>(0.7–1.4)</td>
<td>(0.7–1.3)</td>
<td></td>
</tr>
<tr>
<td><strong>Proteinuria g/24 hours</strong></td>
<td>0</td>
<td>0</td>
<td>NS</td>
</tr>
<tr>
<td><strong>Body weight kg</strong></td>
<td>68 ± 12</td>
<td>63.5 ± 8.9</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>(40–99)</td>
<td>(40–85)</td>
<td></td>
</tr>
<tr>
<td><strong>Body mass index kg/m²</strong></td>
<td>26.2 ± 5.3</td>
<td>24.3 ± 3.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>(18–41.4)</td>
<td>(18–34)</td>
<td></td>
</tr>
</tbody>
</table>

In 14 obese patients (BMI > 30 at the time of nephrectomy), 13 (92%) developed proteinuria/renal insufficiency.

Long-term Morbidity

- Organ Procurement and Transplantation Network (OPTN) database
- A total of 56 previous living donors in 47,996 subsequently listed for cadaveric kidney transplantation (0.04%); 43 have received transplants; 36 currently have functioning grafts; One died after transplantation; Two candidates died while waiting
- 1999 adjusted incident rate for ESRD in the general U.S. population: 315 per million population, or 0.03%

Ellison MD et al, Transplantation 2002
Proteinuria and Reduced Kidney Function in Living Kidney Donors - A Meta-Analysis

- Forty-eight studies from 27 countries followed a total of 5048 donors
- Follow-up: average of 7 years (median 6, range 1–25 years)
- Published from 1973 to 2005
- 21% prospectively followed donors in time
- Four studies described the characteristics of donors lost to follow-up

The average 24 h urine protein was 154mg/day and the average GFR was 86 ml/min.

Kidney donation resulted in small increases in urinary albumin, which increased with the time after donation.
Proteinuria and Reduced Kidney Function in Living Kidney Donors - A Meta-Analysis

- Ten years after nephrectomy, donors had a GFR that was 10 ml/min lower compared to controls
- 12% of donors developed a GFR less than 60 ml/min during follow-up
- However, after the initial decrement in GFR from the nephrectomy, there was no evidence of an accelerated loss in GFR over that anticipated with normal aging
- The pooled incidence of proteinuria: 12%

Donor Evaluation

• Live kidney donor must receive a complete medical and psychosocial evaluation
• Blood typing: often the first test, relatively inexpensive
• Initial cross-match
• Preliminary medical evaluation
Donor Evaluation

- Complete history (*hereditary dz) and physical exam
- Labs (routine, serologies, OGTT for diabetic families)
- UA, urine culture, pregnancy test
- 24 hour urine for protein and creatinine
- GFR measurement (glofil-ideal)
- Chest x-ray, ECG, exercise stress test for patients older than 50 years of age
- CT angio or MRA of renal arteries
- Psychosocial evaluation
- Repeat crossmatch before transplantation
Hereditary Diseases

- Alport’s syndrome
- Diabetes
- Polycystic kidney disease
- FSGS
- IgA nephropathy
- Hypertension
- HUS, SLE, and cystinosis
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- A **GFR**<80 ml/min or 2 SD below normal (based on age, gender, and BSA corrected to 1.73 per m2) generally preclude donation
- Patients with a **BP**>140/90 mmHg by ABPM are generally not acceptable as donors
- Patients with a **BMI**>35 kg/m2 should be discouraged from donating
- **Dyslipidemia** alone does not exclude kidney donation (Keep an eye on “Metabolic Syndrome”)

*Transplantation March 27, 2005*
Amsterdam Forum Guidelines

- A 24 h urine **protein** of >300 mg is a contraindication to donation
- Individuals with a history of **diabetes** or fasting blood glucose ≥126 mg/dl (7.0 mmol/l) on at least two occasions (or 2 h glucose with OGTT ≥200 mg/dl (11.1 mmol/l) should not donate
Persistent Microscopic Hematuria
Two or more positive dipstick urine tests on separate occasions over at least one-month period

Need to undergo
- Detailed family history for TBMN, Alport's syndrome etc
- Urine culture to rule out infection
- 24 hour urine collection to estimate protein, calcium, urate etc
- Cytology to look for malignancy
- Cystoscopy
- Renal imaging: CT-Renal angiogram (or) Intravenous Pyelography to look for Nephrolithiasis, urothelial cancer and also to assess anatomy of renal vasculature

If no urological cause found, then Counseling and option for deferring donation

Deferred donation
- For those willing to undergo further evaluation: Renal Biopsy should be performed
- Further follow-up with PCP

Causes of Persistent Microscopic Hematuria

• **Glomerular** bleeding (common causes, not associated with proteinuria or casts)
  • Thin basement membrane nephropathy (TBMN)
  • Alport Syndrome (early stage) or carrier state
  • IgA nephropathy
Causes of Persistent Microscopic Hematuria

- **Extraglomerular** bleeding
  - Stone disease
  - Hemoglobinopathy (SS/SA hemoglobin)
  - Polycystic kidney disease
  - Benign prostatic hyperplasia (elderly donors)
  - Malignancy (bladder, kidney, prostate)
  - Arteriovenous malformations and fistulas
  - Schistosomiasis (in endemic areas)
  - Hypercalciuria, hyperuricosuria, etc.
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• Asymptomatic potential donor+history of a **single stone** may be suitable if:
  • No hypercalcuria, hyperuricemia, or metabolic acidosis
  • No cystinuria or hyperoxaluria
  • No urinary tract infection
  • No evidence of multiple stones or nephrocalcinosis on CT scan
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• **Stone** formers who should not donate are:
  • Nephrocalcinosis on X ray or bilateral stone disease
  • Stone types with high recurrence rates, and are difficult to prevent
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• A prior history of the following **malignancies** usually excludes live kidney donation:
  • Melanoma
  • Testicular cancer
  • Renal cell carcinoma
  • Choriocarcinoma
  • Hematological malignancy
  • Bronchial cancer
  • Breast cancer
  • Monoclonal gammopathy
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Cardiovascular Risk Assessment

- The clinical predictors of an increased perioperative risk (for non-cardiac surgery) by the American College of Cardiology /American Hospital Association standards fall into three categories: major, intermediate, and minor
- Major predictors: unstable coronary syndromes, decompensated heart failure, significant arrhythmias and severe valvular disease-contraindications to live kidney donation
Amsterdam Forum Guidelines
Cardiovascular Risk Assessment

- Most of the **intermediate predictors**: mild angina, previous myocardial infarction, compensated or prior heart failure, and diabetes mellitus—contraindications to donation
- **Minor predictors**: older age, abnormal ECG, rhythm other than sinus, low cardiac functional capacity, history of stroke, or uncontrolled hypertension—warrant individual consideration
Psychosocial Evaluation of Living Kidney donors

- Sociodemographic history and current status
- Capacity to comprehend information
- Psychological status
- Relationship with transplant candidate
- Rationale and reasons for volunteering to donate
- Knowledge, understanding, and preparing for donation
- Social supports
- Financial status and suitability
Donor Evaluation-Actual Cases

- Microscopic hematuria and renal mass (renal cell carcinoma)
- Unknown pregnancy
- Significant bilateral hydronephrosis
- Horseshoe kidney
- Unrecognized hypertension
- Slightly elevated liver enzymes, + HCV (previously unknown)
- Fibromuscular dysplasia
- EF < 20% on ECHO
- Proteinuria: kidney biopsy IgA nephropathy
# The Impact of BMI on Renal Transplant Outcomes

*Meier-Kriesche HU et al, Transplantation 2003*

## Table 1. Cox proportional hazard model for graft loss by categorized body mass index

<table>
<thead>
<tr>
<th>BMI (kg/m²)</th>
<th>RR</th>
<th>95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;18</td>
<td>1.213</td>
<td>1.110–1.326</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>18–20</td>
<td>1.114</td>
<td>1.044–1.189</td>
<td>0.001</td>
</tr>
<tr>
<td>20–22</td>
<td>1.034</td>
<td>0.976–1.094</td>
<td>0.257</td>
</tr>
<tr>
<td>22–24</td>
<td>0.963</td>
<td>0.912–1.017</td>
<td>0.117</td>
</tr>
<tr>
<td>24–26</td>
<td>1.000</td>
<td>-Reference-</td>
<td></td>
</tr>
<tr>
<td>26–28</td>
<td>1.071</td>
<td>1.008–1.136</td>
<td>0.026</td>
</tr>
<tr>
<td>28–30</td>
<td>1.073</td>
<td>1.004–1.140</td>
<td>0.047</td>
</tr>
<tr>
<td>30–32</td>
<td>1.181</td>
<td>1.098–1.271</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>32–34</td>
<td>1.151</td>
<td>1.055–1.257</td>
<td>0.002</td>
</tr>
<tr>
<td>34–36</td>
<td>1.205</td>
<td>1.084–1.339</td>
<td>0.001</td>
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<tr>
<td>&gt;36</td>
<td>1.385</td>
<td>1.300–1.551</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
Polycystic Kidney Disease

- Potential donor >30 years of age, negative ultrasound, CT or MRI: safe to donate
- Suspected PKD with ultrasound: two or more cysts in individuals 30 years or younger, or two or more cysts in each kidney in those aged 30–59 years, or four cysts in each kidney in those older than 60 years
- Suspected PKD with MRI: If all cysts are to be counted, five cysts or more for 18–29-year-olds, six cysts or more for 30–44-year-olds, six cysts or more for women 45–59 years old, and nine cysts or more for men 45–59 years old

Alessandra B et al, Radiology 2001
Long-term Morbidity

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Number</th>
<th>Percent</th>
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<tbody>
<tr>
<td>Hypertensive nephrosclerosis</td>
<td>20</td>
<td>35.71</td>
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<tr>
<td>Focal glomerularsclerosis</td>
<td>9</td>
<td>16.07</td>
</tr>
<tr>
<td>Chronic glomerulonephritis unspecified</td>
<td>7</td>
<td>12.50</td>
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<tr>
<td>Unknown/not reported</td>
<td>5</td>
<td>8.93</td>
</tr>
<tr>
<td>Malignant hypertension</td>
<td>4</td>
<td>7.14</td>
</tr>
<tr>
<td>Familial nephropathy</td>
<td>2</td>
<td>3.57</td>
</tr>
<tr>
<td>Diabetes—insulin dependent</td>
<td>2</td>
<td>3.57</td>
</tr>
<tr>
<td>Blunt trauma</td>
<td>1</td>
<td>1.79</td>
</tr>
<tr>
<td>Chronic pyelonephritis/reflux nephropathy</td>
<td>1</td>
<td>1.79</td>
</tr>
<tr>
<td>Membranous glomerulonephritis</td>
<td>1</td>
<td>1.79</td>
</tr>
<tr>
<td>Nephritis</td>
<td>1</td>
<td>1.79</td>
</tr>
<tr>
<td>Renal cell carcinoma</td>
<td>1</td>
<td>1.79</td>
</tr>
<tr>
<td>Systemic lupus erythematosus</td>
<td>1</td>
<td>1.79</td>
</tr>
<tr>
<td>Vasculitis</td>
<td>1</td>
<td>1.79</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>56</strong></td>
<td><strong>100.00</strong></td>
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