Complications of Diabetes

Kidney Disease

David Goodman
St Vincent’s Hospital Melbourne
Overview

- Pathogenesis of diabetic nephropathy
- Renal pathology
- Risk factors for diabetic nephropathy
- Incidence & prevalence of renal disease
- Progressive renal insufficiency
- Chronic kidney disease ANZDATA registry
- Dialysis
- Transplantation
Pathogenesis of diabetic nephropathy

- Glomerular hyperfiltration
- Hyperglycaemia & AGE’s
- Activation of Protein Kinase C
- Prorenin
- VEGF (vascular endothelial growth factor)
- TGF-β (transforming growth factor-beta)
- BMP-7 (renal bone morphogenic protein-7)
- Nephrin
Renal Pathology Society classification

- Four classes of glomerular lesions were defined:
  - **Class I**: Isolated *glomerular basement membrane thickening*. Basement membranes are greater than 430 nm in males older than age 9 and 395 nm in females. There is no evidence of mesangial expansion, increased mesangial matrix, or global glomerulosclerosis involving >50 percent of glomeruli.
  - **Class II**: Mild (class IIa) or severe (class IIb) *mesangial expansion*. A lesion is considered severe if areas of expansion larger than the mean area of a capillary lumen are present in >25 percent of the total mesangium.
  - **Class III**: At least one *Kimmelstiel-Wilson lesion* (nodular intercapillary glomerulosclerosis) is observed on biopsy and there is <50 percent global glomerulosclerosis.
  - **Class IV**: Advanced diabetic sclerosis. There is >50 percent global *glomerulosclerosis* that attributable to diabetic nephropathy.
Risk factors for diabetic nephropathy

- Genetic
  - Angiotensin-II type 2 receptor gene (AT2)
  - Aldose reductase gene
- Familial
  - Low birth weight, infant malnutrition
  - Reduced nephron number
- Glycaemic control
- Hypertension
- Obesity
- Smoking
- Oral contraceptive pill
- NOT alcohol
Unadjusted Incident RRT Rate

Australia
Indigenous

New Zealand
Maori
Relative Incidence Rate
Indigenous -v- Non-Indigenous
Australia  2006 - 2008
Number of dialysis patients

- 100 - 200
- 50 - 100
- 20 - 50
- 10 - 20
- 5 - 10
- 2 - 5
- 1 - 2
- 0 - 1
Preventing disease progression

- Hypertension
- Hypertension
- Hypertension
- ACE/A2RA therapy
- Protein restriction (80g/d)
- Reduction in cardiac risk factors
  - Smoking, obesity, cholesterol
Disease management

- Dietary modification
  - Na, K, P, protein & water
  - In addition to diabetic diet!

- Bone disease
  - P binders, avoid Ca & Al
  - Active vitamin D & Calcimimetics

- Anaemia
  - Fe, infusion
  - EPO, sub cut injection, cold storage
Preparation for dialysis

- Pre-dialysis education
- HD/PD/Palliative care
- Creation of AVF
- Back up AVF for PD patients
  - High failure rate
- Insertion of Tenckhoff catheter
- Late start
  - Jugular venous catheter
  - Less CVC use
  - Since dedicated access/CKD nurses

Andrea, Tara & Wendelle
**Figure 12.26**

**Late Referral 2004 - 2008**

% Late Referral of (Total Number of Patients)

<table>
<thead>
<tr>
<th>Year</th>
<th>ATSI</th>
<th>Non-Indigenous</th>
<th>New Zealand</th>
<th>Maori</th>
<th>Pacific People</th>
<th>Non-Indigenous</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>40.0% (195)</td>
<td>26.4% (1754)</td>
<td>26.1% (142)</td>
<td>23.1% (65)</td>
<td>17.4% (253)</td>
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<tr>
<td>2005</td>
<td>33.6% (217)</td>
<td>23.2% (2077)</td>
<td>33.6% (137)</td>
<td>23.0% (74)</td>
<td>13.6% (249)</td>
<td></td>
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<tr>
<td>2006</td>
<td>35.4% (220)</td>
<td>21.6% (2217)</td>
<td>29.1% (168)</td>
<td>16.7% (78)</td>
<td>18.5% (253)</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>31.6% (234)</td>
<td>22.8% (2132)</td>
<td>16.3% (147)</td>
<td>30.3% (76)</td>
<td>20.2% (243)</td>
<td></td>
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<tr>
<td>2008</td>
<td>23.5% (242)</td>
<td>21.7% (2234)</td>
<td>31.8% (151)</td>
<td>21.4% (84)</td>
<td>17.9% (257)</td>
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</table>

Reduction in late referrals
**Figure 12.27**

### Vascular Access Use at First ESRF Treatment

**Haemodialysis 2005 - 2008**

(% Using CVC)

<table>
<thead>
<tr>
<th>Year</th>
<th>Vascular Access</th>
<th>Australia</th>
<th>New Zealand</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>ATSI</td>
<td>Non-Indigenous</td>
</tr>
<tr>
<td>2005</td>
<td>AVF/AVG</td>
<td>58</td>
<td>592 (61.6%)</td>
</tr>
<tr>
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<td>CVC</td>
<td>129 (68.9%)</td>
<td>952 (61.6%)</td>
</tr>
<tr>
<td>2006</td>
<td>AVF/AVG</td>
<td>55</td>
<td>634</td>
</tr>
<tr>
<td></td>
<td>CVC</td>
<td>134 (70.8%)</td>
<td>958 (60.2%)</td>
</tr>
<tr>
<td>2007</td>
<td>AVF/AVG</td>
<td>57</td>
<td>631</td>
</tr>
<tr>
<td></td>
<td>CVC</td>
<td>122 (68.2%)</td>
<td>906 (58.9%)</td>
</tr>
<tr>
<td>2008</td>
<td>AVF/AVG</td>
<td>77</td>
<td>601</td>
</tr>
<tr>
<td></td>
<td>CVC</td>
<td>119 (60.7%)</td>
<td>947 (61.2%)</td>
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</tbody>
</table>

Reduction in CVC use
Prevalence of Haemodialysis ATSI Patients

- High efficiency
- Short duration

Prevalence of Peritoneal Dialysis ATSI Patients

- Patient independence
- Preservation of residual function
- Clearance of middle molecules

- Infection risk increased
- High sugar content, obesity

• AVF
  • Complexity
  • Patient relocation
  • Loss of residual function
Relocation for dialysis

Therese Ryder & Bigani Dube

“East MacDonald Ranges plus local Bush Tucker”
• Brenda, Aboriginal Liaison
• Patient Transport
• Cultural Issues
• Finding Patients

clinic or missed dialysis

Eby (social worker) & Deborah
Patient transport & dialysis attendance

- Dialysis bus x3 seat 6-7 people
- Hostels, Public housing & Town camps
- Pick up all patients for dialysis & Clinic on non-dialysis days

- 80% attendance
- Up to 45 patients booked for 32 slots
  - If turnout > spaces patients prioritized
  - Stat K & deferment form

- No visitors for over 1-2 years due to workload
- Fresenius unit (Public-Private)

- Three missed runs to A&E
  - Large UF volume, too many patients for extra days
  - Tennant Creeks 3 missed runs & return to Alice
NT Indigenous Palliative Care Model

- Respect for culture
- Attachment to land
- Compassion
- No one wants to take responsibility for not accepting dialysis
- Understanding of “payback” risks to family members
- Adopted model for St Vincent’s Palliative care

Joanne, Palliative Care Physician & Team
### Figure 12.9

**New Transplants 1999 - 2008**

(% Transplants with Living Donor)

<table>
<thead>
<tr>
<th>Donor Source</th>
<th>Australia</th>
<th>New Zealand</th>
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<tr>
<td></td>
<td>ATSI</td>
<td>Non-Indigenous</td>
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<tr>
<td></td>
<td>DD</td>
<td>LD</td>
</tr>
<tr>
<td>1999</td>
<td>20 (13%)</td>
<td>266 (38%)</td>
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<tr>
<td>2000</td>
<td>15 (17%)</td>
<td>335 (38%)</td>
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<tr>
<td>2001</td>
<td>18 (14%)</td>
<td>310 (40%)</td>
</tr>
<tr>
<td>2002</td>
<td>0 (0%)</td>
<td>230 (39%)</td>
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<tr>
<td>2003</td>
<td>10 (23%)</td>
<td>215 (41%)</td>
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<tr>
<td>2004</td>
<td>22 (15%)</td>
<td>384 (38%)</td>
</tr>
<tr>
<td>2005</td>
<td>19 (14%)</td>
<td>358 (40%)</td>
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<tr>
<td>2006</td>
<td>24 (11%)</td>
<td>344 (44%)</td>
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<tr>
<td>2007</td>
<td>14 (22%)</td>
<td>330 (45%)</td>
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<tr>
<td>2008</td>
<td>24 (23%)</td>
<td>425 (44%)</td>
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Transplantation

- Many want a new kidney
  - Adherence main contraindication
  - Medical co-morbidities

- Work up delayed
  - Access to cardiac stress testing/cardiologist
  - Tx physician review from Adelaide

- Live donor?
  - High risk of diabetic nephropathy in single kidney
  - ESRF
Transplantation

- Very few on active waiting list
- When kidney offered
  - Flights booked to Adelaide
  - Dialysis if time permits
- Prolonged stay in Adelaide (up to 1 month)
- Multiple blood tests
- Multiple medications
  - Risks of immunosuppression
## Figure 12.25

### Cause of Death 2007 - 2008

<table>
<thead>
<tr>
<th>Mode of Treatment</th>
<th>Cause of Death</th>
<th>ATSI</th>
<th>Non-Indigenous</th>
<th>Maori</th>
<th>Pacific People</th>
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<tr>
<td>2007</td>
<td>Dialysis</td>
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<td></td>
<td>Cardiac</td>
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<tr>
<td></td>
<td>Vascular</td>
<td>157</td>
<td>1325</td>
<td>148</td>
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<tr>
<td></td>
<td>Infection</td>
<td>157</td>
<td>1325</td>
<td>148</td>
<td>54</td>
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<td>Malignancy</td>
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<td>Miscellaneous</td>
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<td>1325</td>
<td>148</td>
<td>54</td>
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<td></td>
<td>Total</td>
<td>157</td>
<td>1325</td>
<td>148</td>
<td>54</td>
<td>154</td>
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</tbody>
</table>

"New Zealand"
Move treatment closer to home

- Peritoneal dialysis
- Barriers to transplantation
- Dialysis bus
Community based dialysis units

“The Demountable”

Jo & Joe.
Home training for the Yeundemu mob
Haemodialysis in health clinics

Santa Teresa Health Centre

Kathleen Wallace takes a machine home