Is there a place for Arteriovenous fistula in young children?

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No conflict of interest

Approved by the Ethics Committee of Robert Debré Hospital (Paris)
• End stage renal disease < 14.5 per million before 5 yo

• Best treatment: preemptive kidney transplantation (1)

• Clinical practice guidelines: peritoneal dialysis (2)

Hemodialysis in children > 20 kg

Arteriovenous Fistula (FAV) rather than central venous catheter (CVC) (3)

– Lower complication
– Best preservation of vascular capital

Aims of retrospective study

• Arteriovenous fistula < 20kg (1988-2015)

• Analyse
  – Feasability
  – Efficiency
  – Longevity
  – Associated morbidities
Material and Methods
(1988-2005)

• Arteriovenous Fistula (AVF)

• Created for Hemodialysis (HD)

• Children < 20 kg
Material and Methods

• 60 Arterioveinous fistula
  12 excluded (transplantation before maturation)

• Study
  – Demographics data
  – Etiology of kidney disease
  – Type and site of vascular access
  – Doppler ultrasound follow up
  – Complications and secondary procedures
Material and Methods

- Pre-operative clinical examination
  - Micro-vascular surgeon

- Doppler ultrasound
  - Specialized angiologist
  - Minimal diameter of veins > 2.5 mm
Surgical procedure

• Microsurgery
  – Termino-lateral anastomosis

  – Superficialization
    • Brachio basilic AVF
    • Radio cephalic AVF (thick adipose tissue)
Surgical procedure

- Anticoagulation prophylaxis
  - Low molecular weight heparin (20 days)
  - Anti vitamin K (if high thrombotic risk)
    - Factor V or MTHFR mutation
    - Deficiency in Protein C or S
    - Nephrotic syndrome
Maturity criteria

- Flow > 600 ml/mn
- Diameter > 6mm
- Depth < 6mm
Results

- 41 children (23 males / 18 females)
- Median age of AVF creation: 3,2 yo (1,5 – 8,1)
- Median weight of AVF creation: 13,5 kg (5,5 – 20)
Results

• Etiology
  – Congenital anomalies of kidney and urinary tract 14 (34.1%)
  – Congenital nephrotic syndrome 9 (22%)
  – Ciliopathy 5 (12%)
  – Primary hyperoxaluria 3 (7.3%)
  – Infantile corticresitant nephrotic syndrome 2 (4.9%)
  – atypical haemolytic syndrome 2 (4.9%)
  – autosomal recessive polycystic kidney disease 1 (2.4%)
  – necrotizing vasculitis 1 (2.4%)
  – bilateral nephroblastoma 1 (2.4%)
  – neonatal stress 1 (2.4%)
  – mitochondrial cytopathy 1 (2.4%)
  – unknown reason 1 (2.4%)
Before AVF

- 20 patients on renal replacement treatment
  - CVC 16 (80%)
  - PD 4 (20%)

- 3 patients: previous history of kidney transplantation
AVF characteristics

- 38 (79%) AVF on the dominant side
- 35 (73%) AVF on the forearm and 13 (27.1%) on the upper arm
- Location
  - 33 (68.8%) radio-cephalic
  - 2 (4.2%) radio-ulnar
  - 10 (20.8%) brachio-basilic
  - 3 (6.3%) brachio-cephalic
CVC characteristics

- Hemodialysis via CVC  
  - 16 before AVF utilization  
  - 2 long time before AVF creation  
  - 3 after AVF failure

- 33 CVC insertions  
  1.57/ patient-year

- Complications: infections +++
Early failure / Age - weight

- 42 / 48 AVF used for HD (87.5%)
- Location 6 early failure
  - Radiocephalic 4
  - Brachio basilic 1
  - Brachio cephalic 1
- Causes
  - Thrombosis 4 (only one thrombotic risk factor)
  - Absent maturation 2
- No statistically significant correlation between early failure / age-weight
- (p=0.152 - p=0.151)
Primary maturation

• 24 / 48 cases (50%)
  – 6 cases abandoned
  – 18 cases were achieved maturation after complementary procedure (1 to 3)

• 24 complementary procedures
  – 6 thrombectomies
  – 4 percutaneous transluminal angioplasties
  – 6 revisions
  – 8 superficializations
Median time to maturation

• 18 weeks (14 – 53 weeks)

• No significantly influence localization AVF (between upper et forearm) \( p = 0.699 \)

No statistically significant correlation between time to maturation/age-weight
\( p = 0.094, p = 0.792 \)
## Patency

<table>
<thead>
<tr>
<th></th>
<th>6 months</th>
<th>1 y</th>
<th>2 y</th>
<th>4 y</th>
<th>6 y</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary patency</strong></td>
<td>52,1</td>
<td>41,7</td>
<td>25</td>
<td>20,8</td>
<td>6,3</td>
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<tr>
<td><strong>Secondary patency</strong></td>
<td>85,1</td>
<td>85,1</td>
<td>80,9</td>
<td>60,4</td>
<td>31,9</td>
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<tr>
<td><strong>Functional patency</strong></td>
<td>97,6</td>
<td>92,7</td>
<td>80,5</td>
<td>45,8</td>
<td>36,6</td>
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</tbody>
</table>
Patency

• No influence of localization of AVF
  – Primary patency \( p=0.31 \)
  – Secondary patency \( p=0.179 \)

• No influence of age and weight on primary patency \( p=0.32 \)

• Secondary patency rate increased in patients > 3 yo and > 13 kg \( p<0.001 \)
Late complications
1,36 / AVF (0 - 5)

• 18 thrombosis
  – 5 during HD
  – 6 on kidney per-operative transplantation +++
  – 7 after kidney transplantation

• 24 stenosis
  – 12 during HD
  – 12 after kidney transplantation
Late complications

High flow

- 12 cases
  - 5 on the upper arm (42%)
  - 7 on the forearm (58%)

- Treatment
  - 4 during HD period
  - 8 after transplantation
Late complications
High flow - treatment

• Surgical closure  4 cases after successful transplantation

• Upper arm
  – 4 procedures (only 1 success transposition of radial artery)

• Forearm
  – LARP (4 attempts/3 successes)
Long term outcomes of patients

- Median duration of HD 0.75 yo (0.05 – 5.34)
  - 3 patients died
  - 38 kidney transplantation
  - 1 graft failure returned on HD via AVF
Discussion

• Best treatment: preemptive kidney transplantation

• Clinical practice guidelines : peritoneal dialysis in younger children

• In children (>20kg) hemodialysis on AVF is recommended
discussion

• Only few studies in literature in young children

• Complications: CVC


NovjanG Chronic hemodialysis in small children. Dial. 2016 Jun;20
## Literature

<table>
<thead>
<tr>
<th>Study characteristics</th>
<th>No of AVF</th>
<th>Primary Failure Rate</th>
<th>1 year Primary Patency Rate</th>
<th>1 year Secondary Patency rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shroff R et al. Pediatr Nephrol. 2016</td>
<td>23</td>
<td>16.67%</td>
<td>100%</td>
<td>No data available</td>
</tr>
<tr>
<td>Kim SM et al. Vasc Specialist Int. 2016</td>
<td>52</td>
<td>17.3%</td>
<td>60.5%</td>
<td>82.7%</td>
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<tr>
<td>Ma A. et al. Pediatr Nephrol 2013</td>
<td>20</td>
<td>20%</td>
<td>No data available</td>
<td>No data available</td>
</tr>
<tr>
<td>Briones L. et al. Pediatr Nephrol. 2010</td>
<td>79</td>
<td>27%</td>
<td>50%</td>
<td>73%</td>
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<tr>
<td>Ramage IJ et al. Am J Kidney Dis. 2005</td>
<td>107</td>
<td>23.36%</td>
<td>No data available</td>
<td>No data available</td>
</tr>
<tr>
<td>Sheth RD et al. Kidney Int. 2002</td>
<td>24</td>
<td>33.3%</td>
<td>50%</td>
<td>74%</td>
</tr>
<tr>
<td>Bagolan P1 et al. J Vasc Surg. 1998</td>
<td>112</td>
<td>10%</td>
<td>No data available</td>
<td>No data available</td>
</tr>
</tbody>
</table>
Discussion

• No influence of age and weight on primary patency

• Secondary patency rate increased in patients > 3 yo and > 13 kg
Discussion

• Late complications
  – Average intervention/ functional AVF $1.36 (0-5)$
  – Thromboses (during kidney transplantation +++)
  – High flow : surgical challenge
AVF or CVC?
CVC

• Still the most used in the world

• Development of policies for pediatric priority on kidney transplantation

• Need to have an experienced surgical and multidisciplinary team
AVF

- Superiority in terms of morbidity and life quality
- Usable in post-transplantation
- Chronic disease with slow evolution
Conclusion

• Best quality of life

• Less complications

• To propose in first intention

• Experimented team