First Week Postoperative Flow Measurements are highly predictive of primary patency of Radiocephalic Arteriovenous Fistulas

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Objectives

Look at factors in the **early postoperative period** that identify radiocephalic fistulas likely to fail

- Volume Flows immediately after Fistula Construction
- Volume Flows in first postop week
Methods

Retrospective single center case series 2008-2013

Inclusion Criteria:
AVF based on radial artery in distal third of forearm

Exclusion Criteria:
Revisions excluded to keep observations independent
Snuff Box fistulas excluded
Methods

Data Collection

Preoperative: Demographics, Medical History, arterial and venous mapping

Intraoperative: Volume flow rate immediately after fistula creation. If the flow was less than 100 ml per minute we revised the fistula and repeated measurements prior to closing skin incision. The final flow was recorded.

Postoperative:
• Depth, Diameter, and Flow at first week postoperative visit
• Primary and secondary patency endpoints
Methods

Volume Flow Rates measured by direct duplex ultrasound. Linear transducers 5-16 MHz

- Aloka Alpha 10
- Aloka Alpha 6
- GE Logic P5
- Terason 3000
Results

• 264 Primary Radiocephalic fistulas studied
• 254 fistulas (96%) had intraoperative flow measured
• 252 fistulas (95%) had flow measured on one week postop visit.
• The one week postop visit (window 1-9 days) was kept in 225 fistulas (85%)
Intraoperative Flow rates in 254 radiocephalic fistulas

Mean Intraoperative Flow 238 (SD 128)
Week one postoperative Flow rates in 252 radiocephalic fistulas

Mean Postoperative Flow 437 (SD 230)
Primary and Secondary Patencies of 264 Primary Radiocephalic Fistulas
Cox Proportional Hazard Regression for Primary Patency:
Only Diabetes, age, and First follow up flow rate were significant contributor to the variability in primary patency.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Conf. (±)</th>
<th>Std.Error</th>
<th>P</th>
<th>Hazard = Exp(Coeff.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension (1=Yes, 0=No)</td>
<td>-0.308478439</td>
<td>0.640409336</td>
<td>0.326741502</td>
<td>0.345115762</td>
<td>0.73456379</td>
</tr>
<tr>
<td>DM 1=yes and 0=no</td>
<td>0.403571348</td>
<td>0.400151115</td>
<td>0.20416001</td>
<td>0.048071037</td>
<td>1.497162048</td>
</tr>
<tr>
<td>Age at date of surgery (years)</td>
<td>0.020784928</td>
<td>0.012746537</td>
<td>0.006503376</td>
<td>0.001393603</td>
<td>1.021002439</td>
</tr>
<tr>
<td>of tobacco smoking (1=Yes, 0=No)</td>
<td>-0.021213063</td>
<td>0.590548665</td>
<td>0.301302225</td>
<td>0.943871629</td>
<td>0.979010352</td>
</tr>
<tr>
<td>nflow Artery Diameter (mm)</td>
<td>-0.349175111</td>
<td>0.426050139</td>
<td>0.217373881</td>
<td>0.108200529</td>
<td>0.705269619</td>
</tr>
<tr>
<td>Preop vein size (mm)</td>
<td>-0.172885429</td>
<td>0.301358695</td>
<td>0.153755399</td>
<td>0.260835496</td>
<td>0.84123399</td>
</tr>
<tr>
<td>Record 1 if male and 0 if female</td>
<td>-0.288761848</td>
<td>0.400575212</td>
<td>0.204376388</td>
<td>0.157687393</td>
<td>0.749190605</td>
</tr>
<tr>
<td>Intra-op Flow (ml/min)</td>
<td>-0.000215675</td>
<td>0.001579927</td>
<td>0.00080609</td>
<td>0.789040423</td>
<td>0.999784348</td>
</tr>
<tr>
<td>First f/u flow (ml/min)</td>
<td>-0.001316412</td>
<td>0.001048075</td>
<td>0.000534736</td>
<td>0.013824229</td>
<td>0.998684454</td>
</tr>
<tr>
<td>follow up fistula diameter (mm)</td>
<td>-0.256047588</td>
<td>0.234455583</td>
<td>0.119620945</td>
<td>0.032315144</td>
<td>0.774105129</td>
</tr>
</tbody>
</table>
Cox Proportional Hazard Regression for Secondary Patency:
Only preop inflow artery size significant contributor to the variability in secondary patency

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Conf. (±)</th>
<th>Std.Error</th>
<th>P</th>
<th>Hazard = Exp(Coef.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension (1=Yes, 0=No)</td>
<td>-0.306935487</td>
<td>0.886103267</td>
<td>0.452096334</td>
<td>0.497191016</td>
<td>0.735698062</td>
</tr>
<tr>
<td>DM 1=yes and 0=no</td>
<td>0.361480409</td>
<td>0.657140959</td>
<td>0.335278099</td>
<td>0.280966435</td>
<td>1.4354529</td>
</tr>
<tr>
<td>Age at date of surgery (years)</td>
<td>-0.018122605</td>
<td>0.020082844</td>
<td>0.010246413</td>
<td>0.076947679</td>
<td>0.982040622</td>
</tr>
<tr>
<td>Use of tobacco smoking (1=Yes, 0=No)</td>
<td>0.572818262</td>
<td>0.903108388</td>
<td>0.46077247</td>
<td>0.213805433</td>
<td>1.77325752</td>
</tr>
<tr>
<td>Preop Inflow Artery Diameter (mm)</td>
<td>-0.997951403</td>
<td>0.743931937</td>
<td>0.379559487</td>
<td>0.008557768</td>
<td>0.36863385</td>
</tr>
<tr>
<td>Preop vein size (mm)</td>
<td>-0.004675255</td>
<td>0.205483351</td>
<td>0.104839101</td>
<td>0.964430465</td>
<td>0.995335657</td>
</tr>
<tr>
<td>Record 1 if male and 0 if female</td>
<td>-0.240269493</td>
<td>0.643218471</td>
<td>0.328174744</td>
<td>0.464083802</td>
<td>0.786415899</td>
</tr>
<tr>
<td>Intra-op Flow (ml/min)</td>
<td>0.000637682</td>
<td>0.002537545</td>
<td>0.001294674</td>
<td>0.622335762</td>
<td>1.000637886</td>
</tr>
<tr>
<td>First f/u flow (ml/min)</td>
<td>-0.000902008</td>
<td>0.00162229</td>
<td>0.000827704</td>
<td>0.275813786</td>
<td>0.999098398</td>
</tr>
<tr>
<td>Follow up fistula diameter (mm)</td>
<td>-0.355492916</td>
<td>0.40650887</td>
<td>0.207403783</td>
<td>0.086526237</td>
<td>0.700827909</td>
</tr>
</tbody>
</table>
Intraoperative Flow
Greater or less than 100 ml/minute: No significant difference in primary patency (p=.25)

Survival Days until end of primary patency

- Green line: Greater than or equal to 100 ml/min
- Red line: LessThan 100 ml/min
- Crosses: Censors
Intraoperative Flow Greater or less than 150 ml/minute: No significant difference in primary patency (p=.28)
Intraoperative Flow
Greater or less than 200 ml/minute: No significant difference in primary patency (p=.07)
Intraoperative Flow
Greater or less than 300 ml/minute: No significant difference in primary patency (p=.88)
Intraoperative Flow
Greater or less than 250 ml/minute: No significant difference in primary patency (p=.89)
POSTOPERATIVE Flow Greater or less than 500 ml/minute: Significant difference in primary patency (p=.002)

Survival Days until end of primary patency
POSTOPERATIVE Flow
Greater or less than 400 ml/minute: Significant difference in primary patency (p<.001)
POSTOPERATIVE Flow
Greater or less than 300 ml/minute: Significant difference in primary patency ($p<.001$)

Survival Days until end of primary patency
POSTOPERATIVE Flow
Greater or less than 200 ml/minute: Significant difference in primary patency (p<.001)

N=25
N=184
Conclusion - Intraoperative Flow

• When we followed our protocol of revising fistulas with initial intraoperative blood flow less than 100 ml per minute, the final intraoperative blood flow was unrelated to outcome.
Conclusion - First Week Postoperative Flow rates

• Flow on the first postoperative visit (first postop week) was the most significant covariate predicting the radiocephalic fistula’s primary patency.

• Patients with flow of less than 200ml per minute should have closer follow up and consideration of surgical or percutaneous intervention

• The safety of early percutaneous intervention was not addressed by our study