Targeting a Successful Fistula: An Overview

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Goal

- Functioning AV Fistula
Purpose

- Identify factors affecting fistula maturation and functioning
- Select best practice approach based on available evidence or consensus
Purpose

- Identify preoperative factors affecting fistula maturation
- Discuss potential impact of such factors
- Minimize unexpected findings
- Select best approach based on preoperative assessment
Successful Fistula: Simplified Principles

- Good vein
- Good Artery
- Connect them appropriately
- Anticipate for complications
Factors for Successful Fistula:

- Anatomic variables
- Selection criteria
- Technical issues/ surgical expertise
- Handling factors
- Surveillance issues/Trouble shooting
- Management of complications
Factors for Successful Fistula:

- Anatomic variables
  - Vein diameter
  - Vein patency
  - Vein tortuosity
  - Vein thickness
  - Distance from artery
  - Artery size
  - Wall Calcifications (location; diabetes; age)
Successful Fistula: Unexpected findings

- Cannot find the vein
- The vein goes into severe spasm
- The vein is sclerotic, thick walled
- The vein has a bad segment
- The vein is far from the artery and needs significant mobilization to reach.
- The artery has a week pulse
- The artery is calcified and cannot be clamped
- The artery goes into severe spasm
Successful Fistula: Simplified Principles

Venous Assessment

History
- Hand dominance
- Prior PIC lines
- Central venous Catheters
- Pacemakers
- AV fistulae
Successful Fistula: Simplified Principles

Venous Assessment

- Physical Exam
  - Inspection
  - Palpation
  - Venous distension with tourniquet
  - Length of continuous available palpable vein
Successful Fistula: Simplified Principles
Venous Assessment

- Duplex Evaluation
  - Vein Diameter
  - Compressibility
  - Intraluminal filling defects, sub-acute obstruction
  - Thickened wall
  - Change in calibers, duplicate systems
  - Major branches
  - Thickness of Subcutaneous tissue
  - Evidence of distal obstruction
Successful Fistula: Simplified Principles

Venous Assessment

- Duplex Evaluation
  - Vein Diameter
    - Hydration, temperature, position, tourniquet
  - Preferable size > 3mm

- Ideal Vein: >3mm, continuous for at least 7cm, compressible, superficial, non thickened wall, no distal obstruction.
Successful Fistula: Simplified Principles
Arterial Assessment

- History
  - Hand dominance
  - Prior AV fistulae
  - Prior Arterial lines
  - Diabetes
  - Vasculitis
  - Finger Ischemia
Successful Fistula: Simplified Principles
Arterial Assessment

- Physical Exam
  - Inspection
  - Blood pressure in both arms
  - Palpation of pulses
  - Allen Test for Palmar arch patency
  - Distance between artery and vein
Successful Fistula: Simplified Principles
Arterial Assessment

- Duplex Evaluation
  - Arterial Diameter
  - Calcification
  - Waveform Analysis
  - Finger pressures
Factors for Successful Fistula:

- Selection Criteria
  - Radiocephalic
  - Brachio cephalic
  - Basilic Transposition (upper arm/forearm)
  - Brachial Transposition
  - One stage vs Two stages
Factors for Successful Fistula:

- Technical issues
  - Surgeon’s expertise
  - Anastomotic configuration:
    - End to side/vs side to side
  - Length of anastomosis
  - Lack of Technical imperfections
  - Use of Heparin
  - Handling of tissues
  - Others (use of dilators; vascular clamps; papaverine; suture material)
Successful Fistula: Unexpected findings

- There is a buckle in the anastomosis
- There is a kink in the vein few cms from the anastomosis
- There is no thrill
- There is a pulse in the fistula
- There is a diminished pulse in the distal vessels
Factors for Successful Fistula:

- Handling factors
  - cannulation time
  - cannulation techniques
  - Dialysis nurse expertise
  - Post fistula arm exercises
  - Thin vs obese patient
Factors for Successful Fistula:

- Surveillance issues
  - Diameter changes
  - Flow changes
  - Clinical assessment by nurses and physicians
  - Use of Protocols
  - Issues while on dialysis
Factors for Successful Fistula:

- Management of complications
  - Lack of maturation
  - Inability to cannulate
  - Inability to achieve required flow
  - Aneurysms
  - Bleeding
Successful Fistula: Simplified Principles
Anticipate Complications

- Antiplatelet Therapy: ASA/ Clopidogrel
- Diabetes Control
- Blood Pressure Control
- Hyperlipidemia Control
- Branches within 5-7 cm from anastomosis
- Distal Obstructive pathology
Non Functioning Fistulae risk factors

- Women
- Elderly
- Diabetic
- Forearm fistula
- Overweight patients
Functioning AV fistulae

- SELECTED STUDIES
Native AV Fistula: Preoperative Evaluation

Predictor for success

N=116; 555 maturation rate
Low probabilities: Hx Stroke, TIA, Increasing age and Dialysis dependency
High probability: Large diameter vein, use large dose heparin MAP >85mmHG

Utility of U/S venous assessment prior to forearm AV fistula Creation

Predictor for success

N=106

Male gender
Cephalic Vein Diameter > 2.6mm

Brimble et al Clinical Nephrology 2002
Clinical Utility of Doppler U/S prior to AV fistula Creation

Likely Failure

Cephalic vein < 1.5-2.0mm
Radial Artery < 1.5-2.0mm

Brimble et al Semin Dial 2001
Forearm Venous distensibility predicts successful AV fistula

n = 17 patients;

Strain-gauge plethysmography

- Distensibility < 50cc/mmHg 100% non functional
- Distensibility > 50cc/mmHg 20% non functional

No difference in Luminal diameter between functional and non functional

Van Der Linden et al Am J Kid Dis 2006
Preoperative radial artery diameter predicts early failure of AV fistula

n=21
11 Diameter <1.5mm failure 45%
10 Diameter >1.5mm failure 0%

Parmar et al Eur J Vasc Endo Surg 2007Am
# Predictors of Successful AV fistula Maturation

<table>
<thead>
<tr>
<th>Successful AVF 80%</th>
<th>Non successful 20%</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDA 2.64mm</td>
<td>1.62mm</td>
</tr>
<tr>
<td>RI after Hyperemia .50</td>
<td>.70</td>
</tr>
<tr>
<td>Q(A) 54.5cc/min</td>
<td>24.1cc/min</td>
</tr>
<tr>
<td>IDV after compression 59%</td>
<td>12.4%</td>
</tr>
</tbody>
</table>

Malovrh Am J Kidney Dis 2002
Predictors of Successful AV fistula Maturation

N=116  80% successful AVF
Internal Diameter Artery IDA
Resistance Index  RI  before and after Hyperemia
Arterial blood Flow  Q(A) before and after Hyperemia
Internal Diameter of Vein
Proximal Vein Compression

Malovrh Am J Kidney Dis 2002
Preemptive Stellate ganglion blockage increase the patency of Radiocephalic AV fistula

<table>
<thead>
<tr>
<th></th>
<th>n=50</th>
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<tbody>
<tr>
<td><strong>Block</strong></td>
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<td><strong>No Block</strong></td>
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</tr>
<tr>
<td>n</td>
<td>25</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Thrill</td>
<td>25/25</td>
<td>13/25</td>
<td></td>
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<tr>
<td>Flow</td>
<td>201cc/min</td>
<td>155cc/min</td>
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<tr>
<td>Maturation</td>
<td>77 days</td>
<td>41 days</td>
<td></td>
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<tr>
<td>Adequate access</td>
<td>19/25</td>
<td>12/25</td>
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</tbody>
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Yildirim et al Scan Cardiovasc J 2006
Radiocephalic and brachiocephalic arteriovenous fistula outcomes in the elderly.

Age did not affect usability, primary or secondary patency

Vein diameter is the major predictor of fistula maturation

- Women
- Elderly
- Diabetic
- Vein Diameter
- Fistula type
Non Functioning Fistulæ

Etiology

- Women
- Elderly
- Diabetic

Median Fistula flow by 6 weeks:
- Matured: 1534 ml/minute
- Non matured: 245 mL/minute, ($P = .03$)
Implementation of an optimized care protocol on the outcome of arteriovenous hemodialysis access surgery.

- Higher primary and secondary patency

<table>
<thead>
<tr>
<th>Condition</th>
<th>Importance</th>
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<tbody>
<tr>
<td>Vascular mapping</td>
<td>1</td>
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<tr>
<td>Vascular calcification</td>
<td>2</td>
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<tr>
<td>Antiplatelets/anticoagulants</td>
<td>3</td>
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<tr>
<td>Antihypertensive meds</td>
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<tr>
<td>Blood pressure</td>
<td>3</td>
</tr>
<tr>
<td>CHF</td>
<td>3</td>
</tr>
<tr>
<td>Systemic vascular disease</td>
<td>3</td>
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<tr>
<td>Diabetes</td>
<td>2</td>
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<tr>
<td>Hyperlipidemia</td>
<td>4</td>
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<tr>
<td>Prior vascular access</td>
<td>1.5</td>
</tr>
<tr>
<td>Ipsilateral CVC</td>
<td>2</td>
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</tbody>
</table>
Study Survey; Practical 1-5

Vascular mapping 2
Vascular calcification 4
Antiplatelets/anticoagulants 2
Antihypertensive meds 2
Blood pressure 2.5
CHF 3.5
Systemic vascular disease 4
Diabetes 4
Hyperlipidemia 3
Prior vascular access 3.5
Ipsilateral CVC 3