Doppler Ultrasound:
is it a third generation AVF surveillance method?

Jose Ibeas.

Servei de Nefrologia
Parc Taulí Sabadell, Hospital Universitari
Barcelona
Disclosures

I have the following potential conflicts of interest to report:

Consulting: Covidien, Medtronic

Owner of a healthcare company: NephroCloud

Financing for educational programs: BARD, Covidien, Medtronic, Gore, Mindray, Rubio, Sonosite, General Electric, Toshiba, Cardiva-Angiodynamics
• Vascular Access Complications:
  - High associated morbidity and mortality
  - Worsened quality of life
  - Hospitalizations
  - Costs

adjusted hazard ratio (HR) of death
• TCC: 1.55 [95% CI: 1.42-1.69, p<0.001]
• UCC: 1.43 [95% CI: 1.33-1.54, p<0.001]
• AVG: 1.08 [95% CI: 0.84-1.38, p = 0.56]
• Problems of Vascular Access:
  
  – Creation:

    • Resources:
      – Radiological: Mapping
      – Surgical: Mapping, Creation or Reconstruction

    • Waiting lists

  – Follow up:

    • Need surveillance protocols
      → Flow?
      → Image?

    • Treatment (Preventive)
      • Interventional
      • Surgical

    • Waiting lists

  – Multidisciplinary requirement (Figure of Coordinator)
Surveillance Advised!
Screening AVF:

– **1st Generation Methods: Monitoring. Specific but not sensitive**
  - Physical exam
  - Pump Flow and pressures of hemodialysis device
  - Adequacy: eKt/V – recirculation

  - Flow
    - Dilution techniques
    - Doppler ultrasound
  - Flow + image
    - **Doppler ultrasound**

– **Acute problem**
  - It depends on radiology
    - Doppler US
    - Angiography
  - **Selected patient**
Morphological Study

- **Anatomical trajectory**
  - Artery – Anastomosis – Vein – Subclavia

- **Stenosis**
  - % reduction of lumen

- **Thrombosis**

- **Masses and collections**
  - Hematomas
  - Abscesses
  - Venous dilations
  - Pseudoaneurysms
  - Seromas

- **Steal**
- **Anatomical anomalies**
Functional study

• Flow
  - Better dysfunction predictor
  - Grafts: measurement of the whole access
  - AVF: measurement in vein and artery

• Better measurement in artery?
• Artery measurement: how much is Qa underestimated?
  - Vein measurement:
    - difficult because of curves, bifurcations, variations in diameter, turbulence
    - an advantage to guide the puncture efficiently?

• Artery:
  - Flow measurement
  - Shape of Doppler wave
**Figure 2. Thrombosis with access blood flow surveillance versus standard care.** Standard care could consist of either venous pressure monitoring or no access surveillance. Abbreviations: RR, relative risk; CI, confidence interval; F, fistula; VP, venous pressure; G, graft; DU, Doppler ultrasound; UD, ultrasound dilution.

**Figure 3. Access loss with access blood flow surveillance versus standard care.** Standard care could consist of either venous pressure monitoring or no access surveillance. Abbreviations: RR, relative risk; CI, confidence interval; DU, Doppler ultrasound; UD, ultrasound dilution.
Vascular access surveillance: an ongoing controversy

William D. Paulson¹, Louise Moist² and Charmaine E. Lok³

¹Charlie Norwood VA Medical Center and Nephrology Section, Department of Medicine, Georgia Health Sciences University, Augusta, Georgia, USA; ²Division of Nephrology, University of Western Ontario, London, Ontario, Canada and ³Department of Medicine, Division of Nephrology, The Toronto General Hospital and The University of Toronto, Toronto, Ontario, Canada

- **Graft:**
  - No patency modification
- **AVF:**
  - Qa decrease thrombosis
  - No patency modification
  - No Doppler US Studies
RR of thrombosis was 0.87 (95% CI, 0.67–1.13) favoring access blood flow monitoring.
Preemptive Correction of Arteriovenous Access Stenosis: A Systematic Review and Meta-analysis of Randomized Controlled Trials

Pietro Ravani, MD, PhD, Robert R. Quinn, MD, PhD, Matthew J. Oliver, MD, Divya J. Karsanji, MSc, Matthew T. James, MD, PhD, Jennifer M. MacRae, MD, MSc, Suetonia C. Palmer, MD, PhD, and Giovanni F.M. Strippoli, MD, PhD

<table>
<thead>
<tr>
<th>Access Loss Study ID</th>
<th>Experimental Events</th>
<th>Control Events</th>
<th>Risk Ratio</th>
<th>RR</th>
<th>95% CI</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access Type = Fistula</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tesselore 2004</td>
<td>4</td>
<td>43</td>
<td>0.67</td>
<td>0.67 [0.19; 2.31]</td>
<td>3.2%</td>
<td></td>
</tr>
<tr>
<td>Tesselore 2003</td>
<td>4</td>
<td>32</td>
<td>0.62</td>
<td>0.62 [0.20; 2.00]</td>
<td>3.6%</td>
<td></td>
</tr>
<tr>
<td>Scalfaro 2009</td>
<td>4</td>
<td>53</td>
<td>0.44</td>
<td>0.44 [0.15; 1.31]</td>
<td>4.1%</td>
<td></td>
</tr>
<tr>
<td>Tesselore 2014</td>
<td>5</td>
<td>28</td>
<td>0.41</td>
<td>0.41 [0.17; 1.01]</td>
<td>6.2%</td>
<td></td>
</tr>
<tr>
<td>Random effects model</td>
<td>156</td>
<td>154</td>
<td>0.50</td>
<td>0.50 [0.29; 0.86]</td>
<td>17.1%</td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: I²-squared=0%, p=0.8983

Access Type = Graft

<table>
<thead>
<tr>
<th>Access Type = Graft</th>
<th>Experimental Events</th>
<th>Control Events</th>
<th>Risk Ratio</th>
<th>RR</th>
<th>95% CI</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ram 2003 (DU)</td>
<td>9</td>
<td>35</td>
<td>0.87</td>
<td>0.87 [0.35; 2.21]</td>
<td>5.7%</td>
<td></td>
</tr>
<tr>
<td>Ram 2003 (Q_A)</td>
<td>9</td>
<td>32</td>
<td>0.96</td>
<td>0.96 [0.38; 2.40]</td>
<td>5.8%</td>
<td></td>
</tr>
<tr>
<td>Moist 2003</td>
<td>9</td>
<td>59</td>
<td>1.01</td>
<td>1.01 [0.42; 2.43]</td>
<td>6.4%</td>
<td></td>
</tr>
<tr>
<td>Mayer 1999</td>
<td>10</td>
<td>35</td>
<td>1.00</td>
<td>1.00 [0.48; 2.10]</td>
<td>9.0%</td>
<td></td>
</tr>
<tr>
<td>Malik 2005</td>
<td>11</td>
<td>97</td>
<td>0.52</td>
<td>0.52 [0.26; 1.03]</td>
<td>10.7%</td>
<td></td>
</tr>
<tr>
<td>Dember 2004</td>
<td>14</td>
<td>32</td>
<td>1.00</td>
<td>1.00 [0.57; 1.74]</td>
<td>16.0%</td>
<td></td>
</tr>
<tr>
<td>Robin 2006</td>
<td>27</td>
<td>65</td>
<td>0.97</td>
<td>0.97 [0.65; 1.47]</td>
<td>29.3%</td>
<td></td>
</tr>
<tr>
<td>Random effects model</td>
<td>355</td>
<td>307</td>
<td>0.90</td>
<td>0.90 [0.71; 1.15]</td>
<td>82.9%</td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: I²-squared=0%, p=0.8173

Random effects model | 511 | 461 | 0.81 | 0.65; 1.02 | 100% |

Heterogeneity: I²-squared=0%, p=0.6929

Test for subgroup differences: Q=3.8, df=1, p=0.0507
• **Stenosis diagnosis capability (III):**
  
  – Δ Qa > 25%: S: 80% and PPV: 89%
  
  – Qa 500 mL/min + Δ Qa > 25%: S and PPV SIMILAR to ONLY SURVEILLANCE
  
  – Qa < 500mL/min + EF (+): SIMILAR to ONLY SURVEILLANCE
  
  – Qa 600-750mL/min + Δ Qa > 25%: S: 92-95%, PPV 79-86%) **BETTER!!!**

• All Qa cut-offs, separately, have similar PPV to physical examination and lower than DU.

• The increase in the cut-off remains controversial, once care increases without any clear benefit and even with potential harm (PTA of stable subclinical stenoses).
Surveillance of arteriovenous accesses with the use of duplex Doppler ultrasonography

Jan Malik¹, Jaroslav Kudlicka¹, Ludmila Novakova², Josef Adamec², Hana Malikova³, Jan Kavan⁴

¹ Third Department of Internal Medicine, First Faculty of Medicine, Charles University in Prague, Prague - Czech Republic
² Department of Fluid Dynamics and Power Engineering, Faculty of Mechanical Engineering, Czech Technical University in Prague, Prague - Czech Republic
³ Department of Anatomy, 2nd Medical Faculty, Charles University in Prague, Prague - Czech Republic
⁴ Department of Radiology, First Faculty of Medicine, Charles University in Prague, Prague - Czech Republic

TABLE 1 - DEFINITION OF STENOSIS USED IN THE AUTHOR’S CENTER BY ULTRASONOGRAPHY

<table>
<thead>
<tr>
<th>Main criteria</th>
<th>Additional criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;50% diameter reduction</td>
<td>&gt;25% decrease of flow volume</td>
</tr>
<tr>
<td>&gt;Twofold increase of peak systolic velocity</td>
<td>Flow volume &lt;600 mL/min</td>
</tr>
<tr>
<td></td>
<td>Residual diameter &lt;2.0 mm</td>
</tr>
</tbody>
</table>

Only 2 main = borderline; 2main+ ≥ additional = significant stenosis.
• Further studies needed?
• Low risk stenosis overtreated, with secondary thrombosis
• Look for the risk the thrombosis instead of stenosis?
• Surveillance but with ethiologic diagnosis
• Patient bedside decision
• Cohort: 50 patients
• Qa determination using US vs BTM and its capability of diagnosing hemodynamically significant stenosis.
• NOTE: hemodynamically significant stenosis: reduction vessel lumen > 50% + increase in PSR of more than 2x (PSR in stenosis > 400 cm/s)

Besides Qa monitoring, the DU detects and characterises the stenosis with regard to its location, etiology, residual diameter, hemodynamic significance.
The impact of access blood flow surveillance on reduction of thrombosis in native arteriovenous fistula: a randomized clinical trial

Inés Aragoncillo¹,², Yésika Amézquita³, Silvia Caldeș⁴, Soraya Abad⁵, Almudena Vega⁶, Antonio Cirugeda¹, Cristina Moratilla², José Ibeas⁶, Ramón Roca-Tey⁷, Cristina Fernández⁶, Borja Quiroga⁸, Ana Blanco⁷, Maite Villaverde⁷, Caridad Ruiz⁷, Belén Martín⁵, Asunción M. Ruiz⁵, Jara Ampuero⁵, Juan M. López-Gómez⁵, Fernando de Alvaro¹

As an intermediate analysis pre-specified in protocol show the results at one-year follow-up
TABLE I - Alarm criteria for an intervention

<table>
<thead>
<tr>
<th>Classical alarm criteria</th>
<th>DU and UDM alarm criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>- 25% Increased dynamic venous pressure.</td>
<td>- 25% or higher decreased in $Q_a$ compared with previous measurement.</td>
</tr>
<tr>
<td>- 25% Decreased pump blood flow.</td>
<td>- $Q_a$ lower than 500 ml/min.</td>
</tr>
<tr>
<td>- 0.2 Kt/V decreased compared with previous measurement.</td>
<td>- Stenotic area with a higher than 50% reduction of blood vessel lumen would be considered</td>
</tr>
<tr>
<td>- More than 10% recirculation using urea method.</td>
<td>as alarm criteria only if it comes with a hemodynamic repercussion criteria defined as</td>
</tr>
<tr>
<td>- Prolonged coagulation time in three consecutive dialysis sessions.</td>
<td>peak systolic velocity (PSV) higher than 400 cm/s, or PSV ratio stenosis/pre-stenosis</td>
</tr>
<tr>
<td>- Cannulation problems in three consecutive dialysis sessions.</td>
<td>higher than 3.</td>
</tr>
<tr>
<td>- Pathologic physical examination with any of the previous criteria.</td>
<td></td>
</tr>
</tbody>
</table>

DU = Doppler ultrasound; UDM = ultrasound dilution methods; $Q_a$ = access blood flow.

thromboses in the first year of follow-up

- $Q_a$ group: 0.022 thromboses per patient/year at risk
- control group: 0.099 thromboses per patient/year at risk

(p = 0.030).
Secondary Patency Hazard Ratio: 0.49
IC 0.239-0.97
p = 0.044

Aragoncillo et al. 2nd PTIVAS, Barcelona 2016
In press
Vein dissection, a rare complication of a fistula puncture readily distinguished by ultrasound

Fig. 1 - Schematic drawing of patient's fistula with the post-anastomotic stenosis and the two vein wall dissection. 1 - Radial artery; 2 - Ulnar artery; 3 - Brachial artery; 4 - Cephalic vein; 5 - Basilic vein; 6 - Colateral vein; 7 - Perforating vein. *New cannulation sites.
Chapters

1. Pre-surgical phase
2. VA Creation
3. VA Care
4. Monitoring and surveillance
5. Complications treatment
6. Catheter
7. Quality indicators
PICO Question

Can Doppler Ultrasound, performed by an experienced examiner, replace fistulography as the gold standard for confirming a diagnosis of significant stenosis in VA?
Meta-analysis made by the Iberoamerican Cochrane group, which included 755 patients in 4 studies over the last 10 years, of which 319 were diagnosed with significant stenosis by fistulography (prevalence: 42.3%). Sensitivity of Doppler US ruled against fistulography for diagnosis confirmation of significant VA stenosis in patients with clinical suspicion of stenosis: 89.3 % (IC 95%: 84.7-92.6 %).

(MetaAnalyst Program, 11.11.2013).
Specificity

94.7 %

(IC 95 %: 91.8 - 96.6 %)

Meta-analysis made by the Iberoamerican Cochrane group, which included 755 patients in 4 studies over the last 10 years, of which 319 were diagnosed with significant stenosis by fistulography (prevalence: 42.3%). Specificity of Doppler US ruled against fistulography for diagnosis confirmation of significant VA stenosis in patients with clinical suspicion of stenosis: 94.7% (95% CI: 91.8 to 96.6%).

(MetaAnalyst Program, 11.11.2013).
Positive and negative predictive values of the EDC according to the prevalence of significant stenosis.

<table>
<thead>
<tr>
<th>PREVALENCE SIGNIFICANT STENOSIS (%)</th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>90</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive predictive value (%)</td>
<td>0.0</td>
<td>65.2</td>
<td>80.8</td>
<td>87.8</td>
<td>91.8</td>
<td>94.4</td>
<td>96.2</td>
<td>97.5</td>
<td>98.5</td>
<td>99.3</td>
<td>100.0</td>
</tr>
<tr>
<td>Negative predictive value (%)</td>
<td>100.0</td>
<td>98.8</td>
<td>97.3</td>
<td>95.4</td>
<td>93.0</td>
<td>89.8</td>
<td>85.5</td>
<td>79.1</td>
<td>68.9</td>
<td>49.6</td>
<td>0.0</td>
</tr>
<tr>
<td>Accuracy (%)</td>
<td>94.7</td>
<td>94.16</td>
<td>93.62</td>
<td>93.08</td>
<td>92.54</td>
<td>92</td>
<td>91.46</td>
<td>90.92</td>
<td>90.38</td>
<td>89.84</td>
<td>89.3</td>
</tr>
</tbody>
</table>
4. Monitoring and Surveillance

Can Doppler Ultrasound, performed by an experienced examiner, replace fistulography as the gold standard for confirming a diagnosis of significant stenosis in VA?

R 4.2) **Doppler Ultrasound** is the first approach recommended for image exploration in the hands of an experienced examiner, thereby eliminating the need for confirming via fistulography, to indicate elective treatment when significant stenosis is suspected.

It is **recommended** that fistulography be reserved for diagnostic image exploration only in cases where US results are non-conclusive and there is a persistent suspicion of significant stenosis.

R. 4.6) **It is recommended using both first and second generation methods for monitoring and surveillance AVFns.**
4. Monitoring and Surveillance

Repeated alteration of any parameter obtained by first and/or second generation screening methods

**FIRST CHOICE IMAGE EXAMINATION:**

**DOPPLER US. MAIN CRITERION FOR DIAGNOSIS OF VA STENOSIS USING DOPPLER US:**

1. Reduction higher than 50% of vascular lumen
2. Peak systolic ratio higher than 2

At least ONE ADDITIONAL CRITERION present:

**MORPHOLOGICAL CRITERION:** residual diameter < 2mm and / or

**FUNCTIONAL CRITERION:**

\[ Q_a (\text{ml/min}) < 500 \text{ (AVFn)} - 600 \text{ (AVFp)} \text{ or } VQ_a > 25\% \text{ if } Q_a < 1000 \text{ (ml/min)} \]

Wait – and – see strategy

**NO elective intervention**

**YES, fulfilled:**

stenosis diagnosed

**YES: elective intervention**

**YES: significant stenosis or high risk of thrombosis diagnosed**

If persistent suspicion:

fistulography

**NO: non-significant stenosis or low risk of thrombosis diagnosed**
R 5.1.1) In the absence of any contraindication, it is recommended that all stenoses with a vascular lumen reduction equal to or higher than 50% and that fulfil stenosis criteria related to high-risk of thrombosis be treated.

R 5.1.2) It is recommended that fistulography be performed when central venous stenosis is suspected.
Doppler ultrasound and calcification score: improving vascular access surveillance

Maria Guedes Marques¹, Carlos Botelho¹, Pedro Maia¹, José Ibeas², and Pedro Ponce³

Table 3. Kruskal–Wallis and Mann–Whitney tests.

<table>
<thead>
<tr>
<th>p-Value</th>
<th>BTM Qa</th>
<th>DU Qa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>0.262</td>
<td>0.575</td>
</tr>
<tr>
<td>Age (threshold 65 years)</td>
<td><strong>0.017</strong></td>
<td><strong>0.012</strong></td>
</tr>
<tr>
<td>Diabetes</td>
<td>0.027</td>
<td>0.100</td>
</tr>
<tr>
<td>Hypertension</td>
<td>0.989</td>
<td>0.924</td>
</tr>
<tr>
<td>First VA</td>
<td>0.036</td>
<td>0.199</td>
</tr>
<tr>
<td>Previous endovascular procedure</td>
<td>0.599</td>
<td>0.478</td>
</tr>
<tr>
<td>SCVS (0–8 score)</td>
<td><strong>0.173</strong></td>
<td><strong>0.020</strong></td>
</tr>
<tr>
<td>Venous pressure (threshold 200 mmHg)</td>
<td>0.203</td>
<td>0.155</td>
</tr>
<tr>
<td>Arterial pressure (threshold −185 mmHg)</td>
<td><strong>0.028</strong></td>
<td><strong>0.015</strong></td>
</tr>
<tr>
<td>OCM (threshold 1.4)</td>
<td>0.868</td>
<td>0.892</td>
</tr>
<tr>
<td>PTH (threshold 400 pg/mL)</td>
<td>0.257</td>
<td>0.239</td>
</tr>
<tr>
<td>Calcium (threshold 8 mg/dL)</td>
<td>0.777</td>
<td>0.918</td>
</tr>
<tr>
<td>Phosphate (threshold 4 mg/dL)</td>
<td>0.138</td>
<td>0.402</td>
</tr>
<tr>
<td>Bicarbonate (threshold 22 mEq/L)</td>
<td>0.615</td>
<td>0.859</td>
</tr>
<tr>
<td>Magnesium (threshold 2.3 mEq/L)</td>
<td>0.234</td>
<td>0.389</td>
</tr>
<tr>
<td>Recirculation (threshold 10%)</td>
<td>0.145</td>
<td>0.266</td>
</tr>
<tr>
<td>Time of dialysis (threshold 48 months)</td>
<td><strong>0.001</strong></td>
<td><strong>0.002</strong></td>
</tr>
<tr>
<td>Time of VA (threshold 48 months)</td>
<td>0.112</td>
<td>0.049</td>
</tr>
<tr>
<td>VA type</td>
<td>0.079</td>
<td>0.021</td>
</tr>
</tbody>
</table>

Note: Bold values indicate significant p value < 0.05.
Neointimal Hyperplasia in Early Arteriovenous Fistula Failure

Prabir Roy-Chaudhury, MD, PhD,1 Lois Arend, MD,2 Jianhua Zhang, MS,1
Mahesh Krishnamoorthy, MS,3 Yang Wang, MD,1 Rupak Banerjee, PhD,3 Antoine Samaha, MD,4
and Rino Munda, MD5

Advances an


Minimal Wall Thickening + Negative Remodeling

Early AVF Failure

25%

100%

25%

50% Increase

50% Increase

10% Increase

10% Increase

Successful

Unsuccessful
Moving Points in Nephrology

Novel Paradigms for Dialysis Vascular Access: Downstream Vascular Biology—Is There a Final Common Pathway?

Natural history of vascular access dysfunction

1. Non-CKD
   - Uremia

2. Advanced CKD
   - Uremia Hemodynamics

3. AVF Non-Maturation
   - Angioplasty
   - Uremia Hemodynamics

4. AVF Restenosis

Arteriovenous access creation

Hemodynamic injury

Matrix metalloproteinases
Peroxynitrite

Oxidative stress

Endothelial dysfunction

Inflammation

MCP-1 Cytokines

Neointimal hyperplasia formation

NO

CKD

ADMA
Vascular remodelling

Swing Segment

Proximal Artery

Outflow Vein

Distal Artery

Healthy Vein

ESRD Vein

Outward remodelling

Outward remodelling & intimal hyperplasia

Intimal hyperplasia

Endothelial cell

Vascular smooth muscle cell (VSMC)

VSMC proliferation

Proliferative VSMC

Calcified VSMC

Osteogenic VSMC

Calcification
walls closing in depends on...

- for vasodilation and thickening of the intima-media should be evaluated
Original Article

Ultrasonographic measurement of intima-media thickness of radial artery in pre-dialysis uraemic patients: comparison with histological examination

Young Mi Ku1, Young Ok Kim1, Ji Il Kim3, Yeong Jin Choi4, Sun Ae Yoon1, Young Soo Kim1, Sun Wha Song2, Chul Woo Yang1, Yong Soo Kim2, Yoon Sik Chang4 and Byung Kee Bang4

1Department of Internal Medicine, 2Radiology, 3General Surgery, 4Clinical Pathology, College of Medicine, The Catholic University of Korea, Seoul, Korea

Fig. 1. B-mode ultrasonography shows intima-media thickness (IMT) and internal diameter of the radial artery in a uraemic patient and a healthy person. IMT is the distance between blood-intima and media-adventitia interface at the far wall of the straight portion at the just above the wrist. See increased IMT of the uraemic patient, compared to the control.

Fig. 2. Histologic examination of radial arterial wall. IMT means the sum of intima and media thickness.

Fig. 6. Correlation of radial artery IMT by sonographic and histologic examinations in 43 uraemic patients.
essten moderada
Predictive model?

Ibeas J, Vidal M, Vallespin J, Amengual MJ et al.

VASCULAR ACCESS STENOSIS: FROM BIOMARKERS TO HISTOLOGY.

COULD BE THE INTIMA MEDIA THICKNESS SURVEILLANCE WITH ULTRASOUND A NEW PREDICTOR?

8th Meeting of the American Society of Diagnostic and Interventional Nephrology. New Orleans, Feb 2012

Ibeas J, Vidal M, Vallespin J, Amengual MJ et al.

VASCULAR ACCESS STENOSIS: INTIMA MEDIA THICKNESS ULTRASOUND SURVEILLANCE.

FROM BASICS TO A RISK PREDICTOR?

10 weeks
New concept of US in VA

Not only flow screening like a 2nd Generation Method

- **Image control**
  - Stenosis
  - Masses and collections
  - ‘Confusing’ or ‘alternative’ collaterals

- **Hemodynamics**
  - Velocities
  - Flow

- **Treatment prioritization**
  - Flow criteria
  - Seriousness of stenosis: risk of thrombosis
  - Dangerous masses: pseudoaneurysms

- **Treatment orientation**
  - Interventional
  - Surgical
  - Conservative

- **US-guided puncture**
  - Deep AVF or difficult to puncture
  - Pathological AVF waiting for treatment

- **Further possibilities**
  - Intima-media hyperplasia control?
Protocolization

Mapping
Surgery
Follow up
Screening
Alarms

Pre - HD
HD

Morphological
Functional

Confirmation
Decision
Prioritization

Treatment
The Process Management: Optimization?

Vascular Access Creation

- VA request
- Visit – Image - Indication
- Joint Outpatient control: Nephro-Vascular Surgery
  "In Situ" Ultrasound
- Prioritization
- Surgery

Vascular Access Follow Up

- Screening Alarm
- "In Situ" Ultrasound - Orientation
- Prioritization
- Confirmation Treatment
- Prioritization
- Interventional Treatment
- Surgeon Visit
- Surgery

Process times
• **Primary Assisted Patency:** 1, 2 and 3 years: 74, 70 and 67 %

• **Maturation failure:** 20%
  • Immediate failure: 12%

---

**Thrombosis / patient / year**

![Graph showing thrombosis rates per patient per year](image_url)
Low level alarm

HIDDEN PATHOLOGY IN 76%

- Peripheral Stenosis: 75%
- Central Stenosis: 9%
- Pseudo: 6%
- Thrombosis: 3%
- Mixed: 7%
Reduction in waiting time for vascular access surgery following an computerized algorithm of clinical priorities gets 80% of starting hemodialysis by native fistula and 80% of fistula reparations on patients in hemodialysis without requirement of catheter.

**J Ibeas, J Vallespin, JR Fortuño, et al.**

**XLVIII ERA-EDTA Congress. Praga, June 2011**
Conclusions

• Doppler Ultrasound not only became a 2nd generation method because of the flow measurement, but in combination with the image it also gives decision-making ability in:
  – Mapping
  – Early diagnosis
  – Treatment
  – Prioritization
  – US-guided puncture

• It can reduce morbidity in patients with high morbidity

• It should be part of the arsenal of Vascular Access Programs and learning how to use it should be included in training plans of the related specialties

• As the behavior of stenoses can vary depending on multiple factors, including vascular remodeling and inflammation, then the balance between vascular dilation and the degree of thickening of the medial intima may determine the stenosis progression of vascular access and could be monitored with ultrasound

• More studies are needed to be able to transfer these new fields of interest into clinical practice
10th Congress of the Vascular Access Society
April 5-8, 2017 | Ljubljana, Slovenia
www.vas2017.org