The HeRO™ Vascular Access Device: A New Solution for the AV Access-Challenged Patient
Learning Objectives

Upon completion of this presentation, participants will be able to:

1. Relate the significance of long-term catheter use to the increased rate of bacteremia, inadequacy of dialysis and risk of mortality in the catheter patient population

2. Summarize key results from the HeRO™ Clinical Study

3. Recognize a HeRO™ device implant patient

4. Describe the appropriate physical assessment/cannulation technique of HeRO™ patients and additional management considerations

5. List characteristics of potential HeRO™ candidates
And I will do this by:

1. CPM data will be used to illustrate the growing prevalence of catheters and extrapolated to current HD data from 2008 USRDS data. KDOQI of 2006 goals will be reiterated.

2. Phase 3 clinical trial showing adequacy and infection data leading to FDA approval of this device as a graft

3. The 3 incisions that define a HeRO implant will be described in detail along with history evidence

4. KDOQI 2006 graft cannulation guidelines will be reviewed along with the subtle physical assessment differences encountered with HeRO

5. Clear inclusion and exclusion criteria will be given emphasizing that this is not an access option for those patients who have AVF or AVG upper extremity options
The Catheter Problem
# The Catheter Problem: Growing Catheter Utilization

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Incidence</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AVF</td>
<td>AVG</td>
</tr>
<tr>
<td>Oct - Dec 2005¹</td>
<td>54%</td>
<td>10%</td>
</tr>
<tr>
<td>Oct - Dec 2006²</td>
<td>41%</td>
<td>13%</td>
</tr>
</tbody>
</table>

¹2006 ESRD CPM (Clinical Performance Measures) Project Table 9
²2007 ESRD CPM (Clinical Performance Measures) Project Table 9
# The Catheter Problem: Growing Access-Challenged Population

**Table 12**: Reasons for catheter placement in adult in-center hemodialysis patients using catheters on their last hemodialysis session during October-December 2006 compared to previous study periods. 2007 ESRD CPM Project.

<table>
<thead>
<tr>
<th>Reason</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>No fistula or graft surgically planned</td>
<td>22%</td>
<td>24%</td>
<td>27%</td>
<td>19%</td>
<td>29%</td>
</tr>
<tr>
<td>Fistula or graft maturing, not ready to cannulate</td>
<td>27%</td>
<td>23%</td>
<td>26%</td>
<td>25%</td>
<td>30%</td>
</tr>
<tr>
<td>Temporary interruption of fistula or graft due to clotting or revisions</td>
<td>14%</td>
<td>12%</td>
<td>11%</td>
<td>10%</td>
<td>12%</td>
</tr>
<tr>
<td>No fistula or graft surgically created at this time</td>
<td>18%</td>
<td>22%</td>
<td>21%</td>
<td>19%</td>
<td>34%</td>
</tr>
<tr>
<td>All fistula or graft sites have been exhausted</td>
<td>12%</td>
<td>13%</td>
<td>11%</td>
<td>18%</td>
<td>19%</td>
</tr>
</tbody>
</table>

58% Growth
The Catheter Problem: Bacteremia

Bacteremia is the second leading cause of hemodialysis patient death and catheters are the primary contributing factor

- KDOQI reports an IJ catheter-related overall bacteremia rate of 1.6-5.5 per 1,000 catheter days
- HeRO™ clinical study used a literature control of 2.3 per 1,000 catheter days
- Femoral catheter bacteremia rates are typically 2 times higher

1KDOQI Clinical Practice Guidelines and Clinical Practice Recommendations 2006 Updates
2Oliver, M., Lynch, L. Estimate of the Risk and Rate of Hemodialysis Catheter-Related Bacteremia. 2006. Hemosphere, Inc. document. (Hemosphere scientific literature review of prospective or randomized studies of tunneled IJ catheters (15 articles) with 20 patients or more).
3Lynch, L. Dialysis Catheter Literature Summary. 2007. Hemosphere, Inc. document. (Hemosphere Scientific literature review of non-device related IJ/SCV catheter infections and device-related femoral catheter infections (4 articles)).
The Catheter Problem: Adequacy of Dialysis

<table>
<thead>
<tr>
<th>Type of Access</th>
<th>Mean Kt/V</th>
<th>% of Patients Kt/V&lt;1.2</th>
<th>% of Patients Kt/V&lt;1.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>AV Fistula</td>
<td>1.57</td>
<td>7%</td>
<td>14%</td>
</tr>
<tr>
<td>AV Graft*</td>
<td>1.62</td>
<td>4%</td>
<td>8%</td>
</tr>
<tr>
<td>Catheter</td>
<td>1.45</td>
<td>18%</td>
<td>30%</td>
</tr>
</tbody>
</table>

*Includes grafts with and without AVFs

- 2006 KDOQI guidelines establish a mean Kt/V target of 1.4
- 30% of catheter patients had a delivered Kt/V less than 1.3, leaving this patient population at risk for increased mortality

12007 ESRD CPM Report. Adequacy of Hemodialysis Table 7.

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The Catheter Problem: Increased Patient Mortality

- The mortality rate increases by **7%** for each **0.1** unit decrease in Kt/V\(^1\)

- There is a **40%** higher mortality rate for catheter patients compared to fistula patients\(^2\)

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The Catheter Problem: Summary

- Catheter utilization is growing
- Number of patients who have exhausted all fistula and graft sites is growing
- High incidence of bacteremia is associated with long-term catheter use
- Measured Kt/V is lower in catheter patients
- Mortality rates are significantly higher in catheter patients compared to fistula patients
The HeRO™ Vascular Access Device Solution
The HeRO™ device is the new long-term permanent access solution for access-challenged and catheter-dependent patients

- Fully subcutaneous surgical implant
- AV access with continuous outflow into the central venous system
- Traverses central venous stenosis allowing for long-term hemodialysis access
The **HeRO™** is intended for use in maintaining long-term vascular access for chronic hemodialysis patients who have exhausted peripheral venous access sites suitable for fistulas or grafts.

The FDA classified the **HeRO™** device as a **graft**.
HeRO™ Implantation: Step 1

Venous Outflow Component Placement

• The outflow component is inserted into the IJV under ultrasound and fluoroscopic guidance and advanced into the mid to upper right atrium

• The outflow component is then tunneled to connector incision at the deltopectoral groove
HeRO™ Implantation: Step 2

HeRO™ Graft Tunneling and Component Connection

- The graft is tunneled from the connector incision to the brachial artery incision.
- The outflow component is trimmed to size and connected to the graft component via the titanium connector.
Arterial Anastomosis

- The ePTFE graft component is trimmed to size and the arterial anastomosis is completed.

- At the end of the procedure, fluoroscopy is used to reconfirm proper outflow component tip placement and absence of kinking with arm movement.
HeRO™ Titanium Connector
HeRO™ Device Clinical Study
HeRO™ Device Clinical Study: Overview

HeRO™ Studies
86 total subjects

Patency Study
Enrollment started July ‘04

HeRO™
50 subjects

2:1 randomization
Graft eligible subjects
12 month follow-up

ePTFE Control
20 subjects

Bacteremia Study
Enrollment started March ‘06

HeRO™
36 subjects

Non-randomized to literature control
Catheter-dependent/poor venous outflow subjects
12 month follow-up
### HeRO™ Device Clinical Study: Demographics

<table>
<thead>
<tr>
<th>Demographics</th>
<th>HeRO™ Bacteremia Study</th>
<th>Prevalent Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average years on dialysis</td>
<td>5.1 ± 4.0</td>
<td>5 yr life expectancy²</td>
</tr>
<tr>
<td>Previous bacteremias</td>
<td>1.8</td>
<td>Not reported</td>
</tr>
<tr>
<td>Mean age (years)</td>
<td>62.7</td>
<td>60.8¹</td>
</tr>
<tr>
<td>Caucasian</td>
<td>50.0%</td>
<td>55.3%¹</td>
</tr>
<tr>
<td>African-American</td>
<td>36.8%</td>
<td>37.2%¹</td>
</tr>
<tr>
<td>Hispanic</td>
<td>13.2%</td>
<td>14.8%¹</td>
</tr>
<tr>
<td>Diabetes Mellitus</td>
<td>68.4%</td>
<td>42.9%¹</td>
</tr>
</tbody>
</table>

- Enrolled patients averaged **over five years** on dialysis and almost **70%** of enrolled patients were diabetic


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## HeRO™ Device Clinical Study: Access History

<table>
<thead>
<tr>
<th>Access History</th>
<th>% of Patients</th>
<th>Range of Prior Accesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous Fistula</td>
<td>66%</td>
<td>1 - 2</td>
</tr>
<tr>
<td>Previous Graft</td>
<td>79%</td>
<td>1 - 5</td>
</tr>
<tr>
<td>Previous Catheter</td>
<td>100%</td>
<td>1 - 16</td>
</tr>
</tbody>
</table>

- Enrolled patients had a mean of **5.4 prior vascular accesses**
HeRO™ Device Clinical Study Results: 70% Reduction in Bacteremia Rates

<table>
<thead>
<tr>
<th>Analyzed Cohorts</th>
<th>HeRO™ Bacteremia Events</th>
<th>HeRO™ Bacteremia Rate/1,000 days</th>
<th>Catheter Literature Control/1,000 Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>HeRO™ w/Bridging TDC (1,373 days)</td>
<td>7</td>
<td>5.1</td>
<td>1.6 - 6.9(^1)</td>
</tr>
<tr>
<td>HeRO™ Alone (8,525 days)</td>
<td>0</td>
<td>0.0</td>
<td>2.3(^4)</td>
</tr>
<tr>
<td>HeRO™ Overall (9,931 days)</td>
<td>7</td>
<td>0.7</td>
<td>2.3(^2)</td>
</tr>
</tbody>
</table>

- 59% of patients with a bridging TDC had a femoral catheter
- **NO** device-related bacteremia events were reported after bridging catheter was removed

\(^1\)Combined bacteremia rate range for femoral and IJ TDCs; IJ TDC range from 2006 K/DOQI Guidelines and femoral TDC range from Lynch, L. Dialysis Catheter Literature Summary. 2007. Hemosphere, Inc. document

\(^2\)Oliver, M., Lynch, L. Estimate of the Risk and Rate of Hemodialysis Catheter-Related Bacteremia. 2006. Hemosphere, Inc. document

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HeRO™ Device Clinical Study Results: Patency

<table>
<thead>
<tr>
<th></th>
<th>HeRO™ Bacteremia Study</th>
<th>Catheter Literature</th>
<th>Graft Literature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patency</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary Patency</td>
<td>44.4%</td>
<td>50%</td>
<td>58%</td>
</tr>
<tr>
<td>Secondary Patency</td>
<td>100.0%</td>
<td>55%</td>
<td>76%</td>
</tr>
<tr>
<td>Functional Patency</td>
<td>72.2%</td>
<td>Not Reported</td>
<td>Not Reported</td>
</tr>
</tbody>
</table>

- No devices were removed due to patency during the study
- Loss of functional patency refers to devices abandoned due to reasons other than patency

1 Lucas, G. Scientific Literature Review for Primary, Primary-Assisted and Secondary Patency in Hemodialysis Catheters and Grafts. 2007. Hemosphere, Inc. document
2 One clinically hypercoagulable subject excluded from this analysis
HeRO™ Device Clinical Study Results: Adequacy of Dialysis

<table>
<thead>
<tr>
<th></th>
<th>HeRO™ Bacteremia Study (N=36)</th>
<th>Catheter Literature(^2)</th>
<th>Graft Literature(^2)</th>
<th>KDOQI Adequacy of Hemodialysis Guidelines(^1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kt/V (mean)</td>
<td>1.7</td>
<td>1.29 - 1.46</td>
<td>1.37 - 1.62</td>
<td>1.4 Target</td>
</tr>
</tbody>
</table>

- HeRO™ device blood flow rates comparable to a graft
- Exceeds KDOQI target Kt/V by 0.3
- Each 0.1 decrease in Kt/V = 7% increase in mortality rate

\(^1\)2006 K/DOQI – Clinical Practice Guidelines for Hemodialysis Adequacy Guideline 4. Minimally Adequate Hemodialysis
\(^2\)Lucas, G. Scientific Literature Review for Hemodialysis Adequacy Reporting Methods and Results 2007. Hemosphere, Inc. document
Primary endpoint to reduce bacteremia was met!

- 70% reduction in device/procedure-related bacteremia compared to catheter literature control

- 1.7 mean Kt/V exceeded the KDOQI target for adequate dialysis
  - Significantly improved vs. the catheter literature control

No devices were removed due to patency issues

- Although the HeRO™ device may require declot intervention similar to a graft
### Clinical Investigational Sites

<table>
<thead>
<tr>
<th>Investigators</th>
<th>Sites</th>
<th>Locations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marc Glickman, MD (PI)</td>
<td>Sentara Hospital</td>
<td>Norfolk, VA</td>
</tr>
<tr>
<td>John Ross, MD (PI)</td>
<td>Bamberg County Hospital</td>
<td>Bamberg, SC</td>
</tr>
<tr>
<td>Jeffrey Lawson, MD</td>
<td>Duke University Medical Center</td>
<td>Raleigh-Durham, NC</td>
</tr>
<tr>
<td>Howard Katzman, MD</td>
<td>Univ. of Miami Hospital</td>
<td>Miami, FL</td>
</tr>
<tr>
<td>Robert McLafferty, MD</td>
<td>Southern Illinois University</td>
<td>Springfield, IL</td>
</tr>
<tr>
<td>Colleen Johnson, MD</td>
<td>North Memorial Medical Center</td>
<td>Robbinsdale, MN</td>
</tr>
<tr>
<td>Jeffrey Martinez, MD</td>
<td>Baptist Medical Center</td>
<td>San Antonio, TX</td>
</tr>
<tr>
<td>Eric Peden, MD</td>
<td>Baylor Medical Center</td>
<td>Houston, TX</td>
</tr>
<tr>
<td>Joseph Zarge, MD</td>
<td>St. Joseph’s Hospital</td>
<td>Atlanta, GA</td>
</tr>
</tbody>
</table>
Recognizing HeRO™ Device Patients
Recognizing HeRO™ Device Patients

Look for three incisions:

- Internal jugular incision
- Deltopectoral groove incision (palpate for device connector)
- Brachial artery incision
Recognizing HeRO™ Device Patients

HeRO™ identification items are provided in the implant kit for the patient to receive post-procedure:

- Identification Information Card
- Patient Information Handbook
- HeRO™ Wristband
- Provider Care & Management Brochure
- Implant Notification Fax Form
HeRO™ Device Care & Cannulation
AVG Physical Assessment: Look, Listen & Feel

- **Look**
  - Uniform sized graft
  - No irregular areas or aneurysm formations
  - Organized cannulation site rotation

- **Listen**
  - Low pitch continuous diastolic and systolic
  - HeRO™ bruit may be slightly softer due to absence of venous anastomosis

- **Feel**
  - Thrill and/or pulse strongest at the arterial anastomosis, but should be felt over the course of the entire graft
  - Easy to compress
  - HeRO™ thrill may also be less prominent
HeRO™ Device Cannulation

Follow KDOQI Guidelines for cannulation:

• Wait until swelling has subsided so the course of the graft can be palpated (at least two weeks prior to first cannulation)
• Use standard fistula needles at a 45-degree angle
• Rotate cannulation sites
• Stay 2-3 cm from the arterial anastomosis
### Techniques for AVG Cannulation

<table>
<thead>
<tr>
<th>Technique</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>For routine AVGs:</strong></td>
<td></td>
</tr>
<tr>
<td>• Advance the needle slowly with the beveled</td>
<td>• Any manipulation may traumatize the vessel intima</td>
</tr>
<tr>
<td>cutting edge up facing the top of the vessel</td>
<td></td>
</tr>
<tr>
<td>• Do not rotate the axis</td>
<td></td>
</tr>
<tr>
<td><strong>For deep, hard to palpate AVGs:</strong></td>
<td></td>
</tr>
<tr>
<td>• Immediately rotate the axis of the needle</td>
<td>• Rotating the axis avoids traumatizing the top of the intima</td>
</tr>
<tr>
<td>180°</td>
<td>• Prevents the needle tip from entering the backside of the graft material</td>
</tr>
<tr>
<td>• Advance needle slowly with the beveled</td>
<td>• This should only be utilized when the graft back-wall location is</td>
</tr>
<tr>
<td>cutting edge down facing the bottom of the</td>
<td>difficult to determine and the risk of continuing needle advancement</td>
</tr>
<tr>
<td>vessel</td>
<td>into the back-wall is high</td>
</tr>
</tbody>
</table>

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## AVG Cannulation Needle Handling

<table>
<thead>
<tr>
<th>Technique</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Pressing the needle shaft flat against the skin moves the tip from the desired position within the vessel lumen</td>
<td></td>
</tr>
<tr>
<td>• Tape the needle at the angle insertion</td>
<td>• Any needle manipulation may traumatize the vessel intima</td>
</tr>
<tr>
<td>• Remove the needle at the angle of insertion</td>
<td>• Avoid pressing the cutting edge of the needle into the intima when applying pressure for hemodialysis</td>
</tr>
<tr>
<td>• Never apply pressure before the needle is completely removed</td>
<td></td>
</tr>
</tbody>
</table>
Additional Considerations For HeRO™ Device Cannulation

- Stay at least **3 inches from the connector incision site**
- **Never** puncture the outflow component
- Tourniquet may be beneficial to dilate graft
- Hemostasis post dialysis should be achieved using digital pressure rather than fistula clamps
- Remove bridging catheter following successful HeRO™ device cannulation
HeRO™ Healthcare Economics
The Catheter Problem: High Cost to the Healthcare System

Bacteremia/septicemia is a significant complication requiring hospital admission in hemodialysis patients.

$23,451 is the mean cost of a catheter-related bacteremia hospitalization.

- 17 day mean length of stay
- MRSA bacteremia associated with longer stays and higher costs

## Potential Healthcare Savings

<table>
<thead>
<tr>
<th></th>
<th>TDC Costs</th>
<th>HeRO™ Device Costs&lt;sup&gt;2&lt;/sup&gt;</th>
<th>HeRO™ Device Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Implant Procedure</strong></td>
<td>$1,466&lt;sup&gt;1&lt;/sup&gt;</td>
<td>$4,006</td>
<td>$(2,540)</td>
</tr>
<tr>
<td><strong>Maintenance Procedures (yearly)</strong></td>
<td>$4,256</td>
<td>$6,307</td>
<td>$(2,051)</td>
</tr>
<tr>
<td><strong>Bacteremia Hospitalization (yearly)&lt;sup&gt;1&lt;/sup&gt;</strong></td>
<td>$19,699</td>
<td>$5,991</td>
<td>$13,708</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$25,421</td>
<td>$16,304</td>
<td>$9,117</td>
</tr>
</tbody>
</table>

- Converting 20,000 catheter patients to HeRO™ devices could result in a potential healthcare system savings of ~$182 million


<sup>2</sup> Economic analysis on file at Hemosphere, Inc.
Identifying HeRO™ Device Candidates
HeRO™ is ideally suited for the large and rapidly growing number of hemodialysis patients who are:

- Catheter-dependent
- Approaching catheter-dependency
- Failing an existing fistula or graft due to venous outflow obstruction or central venous stenosis
HeRO™ Candidate Selection Criteria

Follow KDOQI guidelines for vessel mapping to evaluate patient qualifiers necessary for HeRO™ device placement.

### Necessary Patient Qualifiers:

- ✔ > 3 mm brachial artery
- ✔ Adequate cardiac function (ejection fraction > 20%)
- ✔ Systolic BP > 100 mmHg
- ✔ Infection free
- ✔ Without ipsilateral PM/IADC
Introducing HeRO™ Into Your Access Program
What Will HeRO™ Do For Your Patients and Your Vascular Access Program?

Positively impact the overall health and quality of life for your access-challenged patients

• Significantly reduce catheter-related bacteremia
• Improve adequacy of dialysis over catheters
• Reduce complications experienced with a catheter

Lower your percentage of catheter-dependent patients

Simplify staffing patterns related to care of catheter patients
What Happens Now?

- Review your current catheter-dependent patients to determine eligibility
- Work with your HeRO™ representative to assist in educating the nephrologists and vascular surgeons
Summary of HeRO™ Device Management

- The HeRO™ device is the only long-term, peripheral AV access option for patients with venous outflow obstruction.

- Employ strict infection control procedures as per CDC dialysis precautions to keep HeRO™ patients free from the risks of infection.

- Keep in mind this patient population may require longer than 14 days for tissue to graft incorporation.

- Timely removal of the bridging TDC following successful HeRO™ device incorporation will likely decrease the risk of catheter-related infections.
The HeRO as I see it!

HeRO is not for everybody but it might be just the right device for that patient who has:

- Good brachial flow
- Compromised venous outflow
- No other peripheral access options

AND .................................................................
Remember - It's Always about what is best for the individual Patient!
References and Resources


Questions & Answers