The Case Against Catheters

The Renal Network Learning Session
Chicago, IL
February 12, 2009
Catheter Problems

- Dialysis Adequacy
- Subsequent AVF failure
  - Central Vein Stenosis
- Cost per Treatment
- Infection Risk
- Hospitalization
- Mortality
- Ethical
Dialysis Adequacy
Target $K_t/V = 1.3$

- More alarms ($P_v$ and $P_{art}$) that interrupt treatment
- Maintain $Q_b$ of $\geq 350$
- Low blood flows mitigate advantage of high efficiency dialyzers ($K_oA \geq 800 \text{ ml/min}$)
- $K_dUrea = f(Q_b)$
- More time (min/kg) to the same $K_t/V$
- More shortened treatments
## Impact of Catheters on Kt/V and HDTd

<table>
<thead>
<tr>
<th>n</th>
<th>Cath</th>
<th>≥ 1.3</th>
<th>Kt/V</th>
<th>Min/kg</th>
<th>Short</th>
</tr>
</thead>
<tbody>
<tr>
<td>65</td>
<td>no</td>
<td>no</td>
<td>1.14</td>
<td>2.70</td>
<td>.14</td>
</tr>
<tr>
<td>349</td>
<td>no</td>
<td>yes</td>
<td>1.64</td>
<td>2.98</td>
<td>.07</td>
</tr>
<tr>
<td>96</td>
<td>yes</td>
<td>no</td>
<td>1.03</td>
<td>2.81</td>
<td>.20</td>
</tr>
<tr>
<td>356</td>
<td>yes</td>
<td>yes</td>
<td>1.66</td>
<td>3.14</td>
<td>.09</td>
</tr>
</tbody>
</table>
Effect of Incident Catheter

- AVF have a 65% patency rate in first year after creation if pt started with TCC
- AVG have a 45% patency rate in the first year after creation if pt started with TCC
Fistula and Graft Survival in Incident Patients Starting HD with a Permanent VA

Adjusted for differences in age, gender, diabetes, and peripheral vascular disease; *note: in Japan, there were only a small number (n=88) of incident patients for analysis so confidence interval (C.I.) at one year is much larger than for other countries; in Japan, 1 year AV Fistula survival C.I.=0.60-0.87. DOPPS I

Pisoni et al, Kidney Int, 61:305-316, 2002
Increased cost per treatment

- More EPO use (> u/kg to same Hgb)
- Set up kits (locks, clamps, etc)
- More heparin
  - More heparin during treatment
  - Heparin locks at end of Rx
- Sterile gloves
- Topical antimicrobials, Systemic Antibiotics
- Increased nursing intervention time
- More blood cultures
- More missed treatments
- Shortenend treatments
- High catheter failure rate (50%-90%/year)
Increased Infection Risks

- Bacteremias
  - Osteomyelitis
  - Septic Arthritis
  - Endocarditis
- Outpatient Antibiotic Use
- Hospitalization for sepsis
Bacteremias/100 patient months

<table>
<thead>
<tr>
<th></th>
<th>AVF</th>
<th>AVG</th>
<th>CC</th>
<th>NCC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.2</td>
<td>0.5</td>
<td>5.0</td>
<td>8.5</td>
</tr>
</tbody>
</table>

Guidelines for the Prevention of Intravascular Catheter-Related Infections
## Events by Access Type

<table>
<thead>
<tr>
<th>Events per 100 pt-mos</th>
<th>Fistulas</th>
<th>Grafts</th>
<th>C Cath</th>
<th>NC Cath</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admits</td>
<td>9.40</td>
<td>12.90</td>
<td>20.50</td>
<td>32.00</td>
</tr>
<tr>
<td>Out Pt tabx</td>
<td>2.02</td>
<td>2.39</td>
<td>7.87</td>
<td>7.80</td>
</tr>
<tr>
<td>Out Pt Vnco</td>
<td>1.21</td>
<td>1.72</td>
<td>6.48</td>
<td>7.80</td>
</tr>
<tr>
<td>Pos BlCltrs</td>
<td>.52</td>
<td>.94</td>
<td>5.80</td>
<td>9.95</td>
</tr>
</tbody>
</table>
Increased Hospitalizations

- 30% increase in all cause hospitalization
- 60% increase in hospitalizations for Sepsis
Adj. Risk of Hospitalization Higher for Catheter and Graft Compared to AV Fistula Patients

Relative Risk of Cause-specific Hospitalization by Baseline VA type

Bradbury, 2007
Hospitalizations: First Six Months on Dialysis

Bradbury, 2007
Increased Mortality

- 30% increase in RR annual mortality
- Catheter use explains most of the difference between US and European gross mortality
- Catheter use explains most of the increased first year mortality
- Increased RR of mortality is
  - Reduced for incident patients when converted
  - Reduced for prevalent patients when converted
Catheter Related Mortality in HD Patients

Early Mortality Study

- random sample of 4,802 incident US HD patients participating in DOPPS
- life-table analysis to identify period of elevated risk in 1st year
- cox regression to assess predictors of earlier vs. later mortality
  - Interaction of predictors with time and the association with mortality

Bradbury, 2007
Mortality Rates During 1st Year

<table>
<thead>
<tr>
<th>Mortality*</th>
<th>&lt; 120 days</th>
<th>121-365 days</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>*per 100 person-years</td>
<td>31.0</td>
<td>23.4</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

*per 100 person-years

Figure 1. Estimated hazard function for the Dialysis Outcomes and Practice Patterns Study (DOPPS) II Census \( (n = 4156) \), DOPPS I sample \( (n = 3777) \), DOPPS II sample \( (n = 1025) \), and DOPPS I and II samples \( (n = 4802) \).
There is an Excess of Deaths During the First 120 days for Nearly All Causes

![Graph showing death rates and confidence intervals for different causes of death.](image)

*Figure 2. (Left) Cause-specific mortality rates and 95% confidence intervals for the <120- and 121- to 365-d periods. (Right) Percentage of all deaths during the <120 and 121- to 365-d periods that occur subsequent to withdrawal.*

Bradbury, 2007
# RR death from catheter in year 1

<table>
<thead>
<tr>
<th>Variable</th>
<th>HR</th>
<th>95% CI</th>
<th>p-value</th>
<th>HR</th>
<th>95% CI</th>
<th>p-value</th>
<th>HR</th>
<th>95% CI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age, per 10 years</td>
<td>1.38</td>
<td>1.24-1.52</td>
<td>&lt;0.0001</td>
<td>1.33</td>
<td>1.20-1.47</td>
<td>&lt;0.0001</td>
<td>1.36</td>
<td>1.26-1.46</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Sex (Male vs Female)</td>
<td>0.92</td>
<td>0.73-1.15</td>
<td>0.45</td>
<td>1.02</td>
<td>0.84-1.27</td>
<td>0.75</td>
<td>0.96</td>
<td>0.82-1.13</td>
<td>0.75</td>
</tr>
<tr>
<td>Race (White vs non-white)</td>
<td>1.46</td>
<td>1.12-1.90</td>
<td>0.005</td>
<td>1.39</td>
<td>1.09-1.77</td>
<td>0.008</td>
<td>1.39</td>
<td>1.15-1.67</td>
<td>0.001</td>
</tr>
<tr>
<td>BMI (30.0+ vs. 20.0S&lt;25.0)</td>
<td>0.79</td>
<td>0.54-1.17</td>
<td>0.25</td>
<td>1.05</td>
<td>0.78-1.41</td>
<td>0.4</td>
<td>0.95</td>
<td>0.76-1.20</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Vascular access type</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catheter vs. AVG fistula</td>
<td>1.62</td>
<td>1.05-2.51</td>
<td>0.02</td>
<td>1.42</td>
<td>1.02-2.01</td>
<td>0.03</td>
<td>1.49</td>
<td>1.14-1.95</td>
<td>0.001</td>
</tr>
</tbody>
</table>

† Adjusted for all other patient characteristics in the table, as well as etiology of ESRD, albumin-corrected Ca, PTH, Hgb, Ca x P, pre-ESRD ESP use and 11 co-morbidities;

Bradbury, 2007
Conversion to an AV Fistula or Graft Associated with 30% Lower Mortality

Bradbury, 2007
Comparison RR of pts who dialyzed using an AVF both at beginning and end of 1 year interval (HEMO Study)

<table>
<thead>
<tr>
<th>Conversion</th>
<th>RR</th>
<th>CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCC throughout</td>
<td>3.43</td>
<td>2.42 - 4.84</td>
</tr>
<tr>
<td>AVF to TCC</td>
<td>2.38</td>
<td>1.76 - 3.23</td>
</tr>
<tr>
<td>TCC to AVF</td>
<td>1.37</td>
<td>.81 - 2.32</td>
</tr>
</tbody>
</table>

Allon, 2006
Effect of changing from AVF to TCC

<table>
<thead>
<tr>
<th>Category</th>
<th>OR</th>
<th>CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>↓ Albumin</td>
<td>1.25</td>
<td>1.09 - 1.45</td>
</tr>
<tr>
<td>↓ Weight</td>
<td>1.14</td>
<td>1.06 - 1.22</td>
</tr>
<tr>
<td>↓ enPCR</td>
<td>2.22</td>
<td>1.41 - 3.57</td>
</tr>
<tr>
<td>↑ Non Acc Hosp</td>
<td>1.19</td>
<td>1.06 - 1.32</td>
</tr>
</tbody>
</table>

Allon, 2006
Effect of changing from TCC to AVF

<table>
<thead>
<tr>
<th>Category</th>
<th>OR</th>
<th>CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>↓ Non Acc Hosp</td>
<td>0.93</td>
<td>0.87 - 0.97</td>
</tr>
</tbody>
</table>

Allon, 2006
Vascular Access: Mortality Risk ~ Facility Based Model

RR of Death among Facility Patients per 20% more facility use of indicated access type

- Catheters: 1.16
- Grafts: 1.07
- Fistulae: 1.00

*DOPPS I+II, 1996-2004; n=25,709; adjusted for age, gender, black race, yrs with ESRD, 14 comorbidity classes, baseline Hgb, Kt/V, serum albumin, calcium, PO4, accounted for facility clustering effects; stratified by continent [Japan, US, EUR (Fr,Ge,It,Sp,UK)]; RR based upon access in use at study entry.

Pisoni et al, ASN2005
RR mortality by categories of facility catheter use and ratio of AVG:AVF use

Higher AVG (AVG:AVF = 3:2 or more)
Intermediate AVG
Lower AVG (AVG:AVF = 1:8 or less)

Model adjusted for age, gender, race, time on dialysis, 13 summary comorbid conditions, laboratory values, unit type, stratified by region, and accounted for facility clustering effects. DOPPS I + II

Pisoni et al, 2005
Differences in Facility Vascular Access Explain Much of the Mortality Differences Between the US and Europe in DOPPS

All models were adjusted for age, gender, race, time on dialysis, 13 summary comorbid conditions, laboratory values, and unit type, and accounted for facility clustering effects. DOPPS I + II; n=20,754; EUR=France, Germany, Italy, Spain, and UK.

Pisoni et al, 2005
“With the knowledge that AVFs are promoted by all authorities as the veritable ‘standard of care’ for hemodialysis access, we are obligated as physicians who have taken the Hippocratic oath to uphold our vow to ‘do no harm’ and refuse to place TCCs except as a temporary measure or a last resort.”

Rehman, CJASN, 2009
Techniques & Tools

- Fistula First Change Concepts
- What we learned from TRN Catheter Reduction QIP (2001 to 2003)
Fistula First Change Concepts

1. Routine CQI review of vascular access
2. Early referral to nephrologist
3. Early referral to surgeon for “AVF only”
4. Surgeon selection
5. Full range of appropriate surgical approaches
6. Secondary AVFs in AVG patients
7. AVF placement in catheter patients
8. Cannulation training
9. Monitoring and surveillance
10. Continuing education: staff and patients
11. Outcomes feedback
Access Trends since the FFBI

"All" include dual access  
Spergel, 2008
Catheters 1999 through 2005

![Bar chart showing the percentage of patients with catheters from 1999 to 2005. The chart shows two types of catheters: chronic and total. The chart indicates a general increase in the percentage of patients with catheters over the years.]

1 Chronic catheter defined as a catheter in use for 90 days or longer.
2 Total catheters defined as chronic catheters plus temporary catheters.

Source: 2006 Annual Data Report, ESRD Clinical Performance Measures Project, Centers for Medicare & Medicaid Services
System Requirements for Successful Access Management

- Pre ESRD modality education and choice
- Early surgical referral
- Preoperative imaging (mapping) Regular monitoring of access maturity and performance
- Early, elective intervention
- Evaluate for secondary AVF creation
Dialysis Providers who reduced catheters and increased fistulas

- VAMT and Patient Education
- 100% Referral for new patients
- Overcome barriers by team focused learning and data review
- Early referral, pathways, and protocols
- Patient and staff education
- Transonic Monitoring
- Surgeons accept patients without insurance
- Refer only to surgeons who do AVF preferentially
Successful Strategies I

- Primary Care Teams (PCT and RN)
- Consistent PCT assignments (90 days)
- Celebrate and Advertise the small victories (there are no “small” victories)
- Levels of team involvement (formal and casual)
- Continuous, between meeting communication
- Dedicated staff to manage access plans
- Data showed that excuses were just that -- excuses
- Maintain continuity with Nephrologists for patients in NH
Successful Strategies II

- Focus on the data “we had no idea” -- reject the status quo
- Medical Director meets with “recalcitrant” nephrologist
- Monitoring accesses for maturation and performance
- Selective vascular surgery referral
- Overcome nephrologist’s bias
- Pre-ESRD education
- Staff talk to patients about catheters and access
- Early planning with patient, specific tracking forms
Successful Strategies III

- Communication among caretakers in different venues
- Pre-transfer coordination of access planning
- Without protocols, nothing gets done
- Report results to all involved in access care
- Pre-ESRD --> access, transplant, modality of Rx
- PD patients get AVF with Tenckhoff
- It is all about communication
- Monitoring: phys assessment, Q_{b_{ac}}, and PrP \text{PrP}_{art}
Manage performance to create systems where incentives are aligned to desired behaviors

- Correct education deficits
- Hold surgeons and nephrologists accountable
- Feedback of outcome data
Role of Facility Staff

- Medical Director
- Vascular Access Coordinator
- Vascular Access Team
  - Protocols and Care Paths
  - Data Collection
  - Care Plans
  - Monitoring, Surveillance, Physical Assessment
- Collaboration with the renal network
The dialysis facility must have a medical director who meets the qualifications of 494.140(a) to be *responsible for the delivery of patient care and outcomes* of the facility. The medical director is *accountable to the governing body for the quality of medical care* provided to the patients. Medical director responsibilities include, but are not limited to the following:
§494.150 Condition: responsibilities of the medical director

... include, but are not limited to the following:

   (a) Quality assessment and performance improvement

   (b) Staff education, training and performance

   (c) Policies and procedures. The medical director must –

      1. Participate in the development, periodic review and approval of a patient care manual for the facility; and

      2. Ensure that –

         i. All policies and procedures relative to patient admissions, patient care, infection control, and safety are adhered to by all individuals who treat patients in the facility, including attending physicians and non-physician providers; and

         ii. The interdisciplinary team adheres to the discharge and transfer policies specified in 494.180(f)
Association of Graft Failure Risk with %Nursing Staff at Facility >3 Years

DOPPS 2002 ASN

%Nursing staff at facility >3 years

0-40: 1.00
41-59: 0.84
60-71: 0.77
72-100: 0.74
Association of AV Fistula Failure Risk with %Nursing Staff at Facility >3 Years

DOPPS 2002 ASN

%Nursing staff at facility >3 years

- 0-40: 1.00
- 41-59: 0.70
- 60-71: 0.81
- 72-100: 0.62
Network and Facility QAPI goals the same

- Improve the quality and safety of dialysis-related services
- Improve independence, quality of life, and rehabilitation of individuals [modality choice]
- Encourage and support collaborative activities to ensure achievement of these goals
- Improve the collection, reliability, timeliness and use of data to measure processes of care and outcomes, maintain patient registry, and support the ESRD network program.
Termination of Medicare Coverage
§488.604

- (a) ...failure of a supplier of ESRD service to meet one or more conditions for coverage set forth in part 494 will result in the termination of Medicare coverage
- (b) ... [can be] based solely on supplier’s failure to participate in network activities and pursue network goals as required at §494.180(i) of this chapter
Thoughts on Systems

When placed in the same system, people, however different, tend to produce similar results. -- Peter Senge

Every system is perfectly designed to get exactly the results it gets. -- Donald Berwick

If you do what you always do, you’ll get what you’ve always got. -- W. Edwards Deming

Insanity is doing the same thing over and over and expecting different results -- Albert Einstein