Arteriovenous Access Monitoring with Ultrasound Dilution in a Pediatric Hemodialysis Unit  Boston Children’s Hospital, Boston, MA

BACKGROUND
An arteriovenous (AV) access is the preferred access for dialysis delivery in children and adolescents requiring chronic hemodialysis (HD), but because of their small size, maintenance of these accesses once they are created becomes all the more important. Ultrasound dilution (UD) monitoring of AV access flow is widely used in adult HD units for early stenosis detection, but its experience in pediatrics is limited.

OBJECTIVES
PRIMARY: To evaluate the impact of UD monitoring on AV access-related morbidity, especially access thrombosis. Secondary morbidity outcomes were also evaluated including access-related hospitalizations, and need for new access creation or temporary dialysis catheter placement.
SECONDARY: To evaluate UD monitoring to screen for hemodynamically significant AV stenosis by:
1. Differentiating between patent AV accesses and those at true risk to thrombose.
2. Detecting improvements in blood flow to restore patency after interventional procedures.
3. To determine UD’s sensitivity and specificity for detecting stenoses vis á vis fistulagrams?

METHOD
HD patients with AV accesses were monitored using UD technology whose effectiveness was accessed by comparing its results to fistulagrams and its impact on AV-related morbidity.

<table>
<thead>
<tr>
<th>PERIOD</th>
<th># OF PATIENTS</th>
<th>TIME ON HD</th>
<th># OF UD MEASUREMENTS</th>
<th>ACCESS AGE (at monitoring onset)</th>
<th>MONITORING LENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>14 (5 AVF)(9 AVG)</td>
<td>24 months</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Intervention</td>
<td>16 (7 AVF)(9 AVG)</td>
<td>8 months</td>
<td>164</td>
<td>12 months</td>
<td>5 months</td>
</tr>
</tbody>
</table>

RESULTS
- AV access thrombosis rates fell from 13.5 per 100 patient-months on HD during the baseline period to 3.5 per 100 patient-months on HD during the screening period (p < 0.04).
- Secondary complications (hospitalizations, new access creation, temporary dialysis catheter placement) declined from 4 events per 100 patient-months during baseline period and to 2.5 events per 100 patient-months during surveillance period.
- Mean blood flow rate by UD measurement was lower in AV accesses that went on to thrombose compared to those without thrombosis (1,203 ml/min/1.73 m2 vs. 1,683 ml/min/1.73 m2, p < 0.001).
- Following angioplasty, median flow rate increased from 730 ml/min to 1,180 ml/min.
- When compared to fistulagrams, UD surveillance was 94% sensitive and 77% specific in detecting hemodynamically significant stenosis, with positive and negative predictive values of 83 and 91% respectively.

CONCLUSION
Noninvasive UD screening is very sensitive in detecting hemodynamically significant stenosis and can decrease AV access thrombosis rates.

TAKE HOME POINTS
- Prestigious children’s hospital publishes report of direct clinical benefits through successful use of ultrasound dilution AV access flow trending over time as a surveillance strategy.
- These results support earlier studies by Goldstein et al from Baylor Hospital in Houston.

REFERENCE