PERITONEAL AND VASCULAR ACCESS

Mary L. Brandt, MD  
Professor of Surgery and Pediatrics  
Baylor College of Medicine  
mary.brandt@bcm.edu  
@drmlb
Recognition and Thanks

To those whose ancestral land we are standing on, the Osage Nation.
HELP! I CAN’T CONVINCE MY SURGEONS TO DO DIALYSIS ACCESS THE RIGHT WAY!

Mary L. Brandt, MD
Professor of Surgery and Pediatrics

Baylor College of Medicine
mary.brandt@bcm.edu
Let's fire away, shall we?
SURGICAL ASPECTS OF PEDIATRIC DIALYSIS ACCESS

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mary.brandt@bcm.edu
... a critical issue for these patients is to provide adequate vascular access for current RRT requirements without compromising future potential access sites. Because this requires a different surgical philosophy, it is important to develop a team composed of surgeons, pediatric nephrologists, and dialysis nurses interested in these unique challenges."
When, who and how…

- Referral at CDK Stage IV to surgeon (or presentation at multi-disciplinary team meeting)
- Plan for pre-emptive AVF whenever possible (and at least 3 months before anticipated need!)
- Education for PCPs and EDs re: early referral and vein preservation
When, who and how…

- Nephrology needs to recognize that access to the OR and the surgeon’s schedule = EARLY planning!
- Surgery residents (and some attendings) need be gently taught that children with ESRD are not like adult renal patients – the orders are complicated
- “Gingerman principle”
Friendship and an occasional beverage are effective tools in solving problems with communication between colleagues...
Need for renal replacement therapy identified

Candidate for pre-emptive transplant
- Proceed with transplant evaluation
- No

Contraindications to home peritoneal dialysis
- No
  - Arrange for placement of PD catheter
- Yes
  - Initiate hemodialysis discussion

Educate patient
  - Tour dialysis unit
  - Child life specialist
  - Explain pros/cons AVF vs. CVL
  - Consider peer to peer education
Discuss planning with vascular access surgeon
  - Obtain imaging
  - Discuss maturation
  - Plan/timeframe
Post placement
  - Monitor access maturation
  - If no maturation after 6–10 weeks, discuss with transplant surgeon re revision/intervention
  - Consider routine vascular access rounds in dialysis unit
Table 71.1  Benefits of peritoneal dialysis

<table>
<thead>
<tr>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home treatment</td>
</tr>
<tr>
<td>Self control of the therapy</td>
</tr>
<tr>
<td>No needles</td>
</tr>
<tr>
<td>Facilitates school attendance/employment</td>
</tr>
<tr>
<td>Extended travel is possible</td>
</tr>
<tr>
<td>Better preservation of remaining kidney function</td>
</tr>
<tr>
<td>Lower doses of medication needed to treat anemia</td>
</tr>
<tr>
<td>Better results after kidney transplantation</td>
</tr>
<tr>
<td>Less abrupt fluid shifts than hemodialysis</td>
</tr>
<tr>
<td>Easy to learn (3–5 days)</td>
</tr>
<tr>
<td>High level of patient satisfaction and well-being</td>
</tr>
</tbody>
</table>
PLACING PD CATHETERS
Choosing the catheter

- Three choices to make
  - Straight vs curled
  - One vs two cuffs
  - Straight vs Swan Neck
PD CATHETERS
Straight vs. Curled?

- No data to show curled is better than straight tip
- Often the real issue is the length between the cuff and the end of the catheter (i.e. does it fit the patient?)
PD CATHETERS

Swan Neck?

- Pre-bent catheter insures downward facing exit site
- May not be possible for small children
- Better outcomes in adult studies
PD CATHETERS

Single vs. Double cuff

- Distance between cuffs can be a problem in small patients but double preferred when possible
- Single cuffs often used in small children, double if older
PLACING PD CATHETERS
Principles (open or laparoscopic)

- Choose an optimal exit site
- Create an oblique tunnel through the abdominal wall
- Position the tip in the pelvis
- Create a watertight subcutaneous tunnel
- Do an omentectomy when possible
PLACING PD CATHETERS

Exit Site

- If possible, downward
- If not, lateral
  - never upward
  - less infection
  - infection easier to treat
PLACING PD CATHETERS

Exit Site

- Avoid excessive bend (displacement from catheter memory)

- Exit site ~ 2 cm from subcutaneous cuff
  - >2cm = granulation tissue (infection)
  - <1.5cm = extrusion
PLACING PD CATHETERS

Exit Site

- No suture at exit site
- Ischemia of skin
- FB reaction
- **DO FIX SECURELY**

NO!!!
PLACING PD CATHETERS
Abdominal Wall

- Key is an **oblique** path through abdominal wall rather than a straight shot
- The deep cuff will be secured between the anterior and posterior sheaths, in the muscle
PLACING PD CATHETERS

Subcutaneous Tunnel

Subcutaneous tunnel tight with minimal tissue damage
- Peel away sheath
- Steinman pin
- Not a hemostat!
- Tiny exit site
  - Skin punch biopsy to make incision
PLACING PD CATHETERS

Omentectomy

- Convincing data that omentectomy helps prevent early failure
- Easy for both open and laparoscopic cases

Table 2: Catheter failure within two months of placement

<table>
<thead>
<tr>
<th></th>
<th>Functioning catheter</th>
<th>Catheter failure (n = 36)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median age *</td>
<td>13 y</td>
<td>9 y</td>
</tr>
<tr>
<td>Laparoscopic catheters</td>
<td>57.6%</td>
<td>52.8%</td>
</tr>
<tr>
<td>Open catheters</td>
<td>42.4%</td>
<td>47.2%</td>
</tr>
<tr>
<td>Curled catheters</td>
<td>49.4%</td>
<td>44.4%</td>
</tr>
<tr>
<td>Straight catheters</td>
<td>50.6%</td>
<td>55.6%</td>
</tr>
<tr>
<td>Upper abdominal exit site</td>
<td>51.8%</td>
<td>63.9%</td>
</tr>
<tr>
<td>Lower abdominal exit site</td>
<td>48.2%</td>
<td>36.1%</td>
</tr>
<tr>
<td>Previous abdominal surgery</td>
<td>51.8%</td>
<td>63.9%</td>
</tr>
<tr>
<td><strong>Simultaneous omentectomy</strong> **</td>
<td>72%</td>
<td>28%</td>
</tr>
<tr>
<td>Weight &lt;10 kg ***</td>
<td>10.6%</td>
<td>41.7%</td>
</tr>
<tr>
<td>Weight &gt;10 kg</td>
<td>89.4%</td>
<td>58.3%</td>
</tr>
<tr>
<td>Postoperative infection</td>
<td>5.9%</td>
<td>8.3%</td>
</tr>
</tbody>
</table>

* P = .002 for age.
** P = .042 vs. omentectomy.
*** P < .001 for weight below 10 kg.

Plan incisions, angles by marking on the skin before starting.
Site of incision (skin, subq, anterior fascia)

Exit site

Omentum pulled out of umbilical trocar site for omentectomy
PD CATHETERS
Laparoscopic Placement

- Incision in anterior rectus, spread muscle to expose posterior fascia
- Long needle (under lap guidance) through posterior fascia guided pre-peritoneal towards pelvis – as long a tunnel as possible
- Seldinger technique 18Fr peel-away sheath
Wire placed for peel away sheath
Track between the peritoneum and posterior fascia

Peel away sheath entering peritoneal cavity near midline, caudally
Catheter placed posteriorly in the midline
Site of incision
(skin, subq, anterior fascia)

Exit site
Need for renal replacement therapy identified

Candidate for preemptive transplant → Proceed with transplant evaluation

Contraindications to home peritoneal dialysis

- No
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  - Consider routine vascular access rounds in dialysis unit
AV FISTULAE

Advantages

- Longer patency rate
- Lower complication rate
- No foreign body
Fig 1. Primary patency of pediatric vascular accesses is shown. The *error bars* show the standard error.
AV FISTULA

H&P

- Dominant arm?
  - Fistula should go in non-dominant arm

- Previous IV access?
  - Must have ultrasound mapping
  - Will probably need MRV or (rarely) venogram to assess for stenosis

- Edema?
  - Can’t do it in that arm

- Pulses/Allen test
AV FISTULA
Vein Mapping

- Ultrasound “map” of the veins
  - Location
  - Size
  - Patency
- Usually done by the operating surgeon
- Often repeated the day of surgery to confirm
- Considered standard of care
<table>
<thead>
<tr>
<th>Artery</th>
<th>Vein</th>
<th>Fistula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radial</td>
<td>Cephalic</td>
<td>Wrist</td>
</tr>
<tr>
<td>Brachial</td>
<td>Cephalic</td>
<td>Antecubital</td>
</tr>
<tr>
<td>Brachial</td>
<td>Basilic</td>
<td>Forearm</td>
</tr>
<tr>
<td>Brachial</td>
<td>Basilic</td>
<td>Upper arm/transposed</td>
</tr>
<tr>
<td>Femoral</td>
<td>Saphenous</td>
<td>Thigh</td>
</tr>
</tbody>
</table>
AV FISTULAE

Bresio-Cimino fistula (radio-cephalic)

3 mm
AV FISTULAE
Bresio-Cimino fistula (radio-cephalic)

- Vascular surgeons often intimidated by the size of these vessels in small children
- Role for plastic or other microvascular surgeons?
AV FISTULAE

Upper arm cephalic
AV FISTULAE

Upper arm cephalic

- 18 upper arm fistulae
- 6/18 required interventions (angioplasty)
- 74% 2 year patency rate

Intermediate-term patency of upper arm arteriovenous fistulae for hemodialysis access in children
AV FISTULAE
Upper arm transposed brachial
AV FISTULAE
Upper arm transposed brachial

- 31 patients
- 15 (31%) two stage BVT

AV GRAFTS

- Grafts are the absolute last-ditch access if all else has failed in the hands of the best surgeon available.
- Therefore, grafts are incredibly rare (and should be) in children.
What’s holding us back?

Barriers, biases, and beliefs about arteriovenous fistula placement in children: A survey of the International Pediatric Fistula First Initiative (IPFFI) within the Midwest Pediatric Nephrology Consortium (MWPNC)

Deepa H. CHAND,1 Denis GEARY,2 Hiren PATEL,3 Larry A. GREENBAUM,4 Corina NAILESCU,5 Michael E. BRIER,6 Rudolph P. VALENTINI7

1Pediatric Nephrology and Hypertension, Rush University Medical Center, Chicago, Illinois, USA;
2Pediatric Nephrology and Hypertension, Hospital for Sick Children, Toronto, Ontario, Canada;
3Pediatric Nephrology and Hypertension, Nationwide Children’s Hospital, Columbus, Ohio, USA;
4Pediatric Nephrology, Emory University and Children’s Healthcare of Atlanta, Atlanta, Georgia, USA;
5Pediatric Nephrology and Hypertension, Riley Hospital for Children, Indianapolis, Indiana, USA;
6Department of Veteran’s Affairs, Nephrology and Hypertension, University of Louisville, Louisville, Kentucky, USA; 7Pediatric Nephrology and Hypertension, Children’s Hospital of Michigan, Detroit, Michigan, USA
Table 3  Impediments to AVF placement

<table>
<thead>
<tr>
<th>Identified impediment</th>
<th>Average score (scale 1–8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient/parent resistance</td>
<td>3.5</td>
</tr>
<tr>
<td>Impending transplant</td>
<td>3.5</td>
</tr>
<tr>
<td>Patient age</td>
<td>3.7</td>
</tr>
<tr>
<td>Patient size</td>
<td>3.1</td>
</tr>
<tr>
<td>Poor vasculature</td>
<td>3.4</td>
</tr>
<tr>
<td>Surgeon resistance</td>
<td>5.7</td>
</tr>
<tr>
<td>No nephrologist referral</td>
<td>5.0</td>
</tr>
<tr>
<td>Nurse resistance to “sticking”</td>
<td>6.6</td>
</tr>
</tbody>
</table>

WE HAVE MET THE ENEMY AND HE IS US.
Reducing central venous catheters in chronic hemodialysis—a commitment to arteriovenous fistula creation in children

Rossana Baracco · Tej Mattoo · Amrish Jain · Gaurav Kapur · Rudolph P. Valentini

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Autologous arteriovenous fistulas for hemodialysis using microsurgery techniques in children weighing less than 20 kg

Vasiliki Karava¹ - Pascal Jehanno² - Theresa Kwon¹ - Georges Deschênes¹ - Marie-Alice Macher¹ - Pierre Bourquelot³

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In conclusion, AVF is feasible in young children, showing an early failure rate at 12.5%. Time to maturation is longer than in older children, but primary and secondary patency rates are excellent. Therefore, we recommend that pediatric HD centers establish a strategy supporting AVF creation in young children when PD is contraindicated and pre-emptive KT is not feasible.
Obstructed pipes can’t flow
VEINS ARE THE LIFELINE FOR RENAL PATIENTS!

- Major veins are needed for HD catheter placement
- Upper extremity veins are needed for runoff for future fistulae

ALL PTS WHO MAY NEED DIALYSIS NEED THEIR VEINS PROTECTED AS A PRECIOUS RESOURCE!!!!!
Subclavian Stenosis

- Zingraff 1983: 5/15 pts after 1 week
- Spinowitz 1983: 6/13 pts after 2-6 weeks
- Stalter 1986: 47% of adult patients studied after catheters removed

- These studies were smaller catheters (TPN, chemo)
- Probably HIGHER % for HD catheters
- Probably HIGHER % in children (with smaller veins)
NO SUBCLAVIAN CATHETERS IN ANY RENAL PATIENT!!!(for meds, TPN or dialysis!!!
EXTERNAL CATHETERS

Advantages

- Quickly placed
- Can be used immediately
- No pain with access = improved QOL?
- No – good data that there is no difference in QOL between catheters and fistulae in children!
EXTERNAL CATHETERS

Disadvantages

- Catheter malfunction
  - ~85-90% of catheters
  - ~ 30-65% 12 mo survival
- Infection
- Malposition
- Thrombosis or stenosis of vein
HEMODIALYSIS ACCESS

Hemodialysis Catheters

- Critical message: FISTULAS FIRST!

- Catheters only for
  - Little kids (<10-20 kg)?
  - Short time on dialysis
  - No anatomy for fistulae
EXTERNAL CATHETERs

Pick the right catheter

<table>
<thead>
<tr>
<th>Table 16.2</th>
<th>Estimate of catheter size based on patient weight</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dual lumen catheters</strong></td>
<td></td>
</tr>
<tr>
<td>8 French up to 20 kg</td>
<td></td>
</tr>
<tr>
<td>10 French from 20 to 30 kg</td>
<td></td>
</tr>
<tr>
<td>11.5 French above 30 kg</td>
<td></td>
</tr>
<tr>
<td><strong>Tesio catheters</strong></td>
<td></td>
</tr>
<tr>
<td>7 French from 20 to 40 kg</td>
<td></td>
</tr>
<tr>
<td>10 French from 40 to 60 kg</td>
<td></td>
</tr>
<tr>
<td>12 French above 60 kg</td>
<td></td>
</tr>
</tbody>
</table>
EXTERNAL CATHETERS
Surgical Tricks

- Jugular is where the catheter goes (RIJ preferred)
- Never the subclavian!
- Ultrasound guidance is standard of care
- Lateral puncture = lower risk of kinks
Need for renal replacement therapy identified

Candidate for preemptive transplant

Proceed with transplant evaluation

Contraindications to home peritoneal dialysis

No

Arrange for placement of PD catheter

Yes

Initiate hemodialysis discussion

Educate patient
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Recognition and Thanks

To all my nephrology colleagues and patients at Texas Children’s, past and present
Recognition and Thanks

To all of you (and to your colleagues at home). Never forget that you save lifetimes every day – which is noble and sacred work!
THANK YOU!!!!
Please email with questions!
mary.brandt@bcm.edu