Tale of Neglected Aneurysm

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Chief, Nephrology Section
Salisbury VAMC, NC

How do you define Aneurysm?
When and How do you treat?

KDOQI definition
- 1.5 -2.0 times the size of the native mature vein

Pathogenesis
- Repeated punctures at same site
- Outflow stenosis
- High blood flow rate combined with longer duration of AVF

Clinical spectrum of AV access aneurysm
- Asymptomatic
- Rapid increase in size
- Difficulty in needle cannulation
- Poor blood flows during dialysis often related to needle position
- Intra-aneurysmal thrombus formation
- Infection
- Degeneration of the overlying skin
- Bleeding or life threatening hemorrhage
- Unsightly appearance
- High output cardiac failure

Monitoring
- No standard definition
- No standard staging /treatment guidelines
Most common treatment plan

- Wait and watch until imminent rupture
- **Indication for surgery – imminent rupture!!!** (4-5 times the normal size)
- Why do we wait until the aneurysm/pseudoaneurysm is large enough to rupture?

Critical need for awareness

- Normal size of Abdominal Aorta – 2-2.5cm
- Indication for surgery for AAA
  - Size > 5.5 cm (twice the normal size)
- AVF size 0.6 -1.1cm
- AVG size 0.6 cm

Indications for surgical referral

- Thin, shiny and atrophic overlying skin with or without ulcerations
- Evidence of spontaneous bleeding
- Rapid increase in aneurysmal size
- Evidence of infection
- Limited suitable segment for cannulation
- Cosmetic appearance

Stent graft for small pseudoaneurysm

- AVG with pseudoaneurysms
- Unreliable transonic measurements
- High recirculation rate
- Potential risk of rupture
Vascular access hemorrhages contribute to deaths among hemodialysis patients

Katherine D. Ellingson, Rakhee S. Palekar, Cynthia A. Lucero et al.

Fatal Vascular Access Hemorrhage

- Common complications – stenosis, thrombosis, infection are not life threatening
- Etiology and epidemiology of FVAH is not well described in literature – Risk Management / Medico-legal Issue
- Risk factors for spontaneous rupture are not well described
- CDC in 2007 alerted about the cluster of deaths from FVAH in Maryland

Sample case

A 66-year-old male was in his bathroom at home when he started bleeding profusely from his High Intermittent AV (HIAV) graft. He applied compression to the site and told his mother to call 911. The patient was transported to the emergency room, but was pronounced dead on arrival. The patient had documented stenosis of his AV graft 2 weeks earlier. He had been last dialyzed 2 days before death and at that time had a clod over the access noted when dialysis began. The Medical Examiner determined that his access had eroded and ruptured.

Results

- CMS national data – 0.4% incidence
  - 1654 deaths due to FVAH
  - 430,887 total HD deaths
- Regional query identified 142 deaths
- 89 charts were available for review
- 88 confirmed deaths from FVAH from 58 facilities

<table>
<thead>
<tr>
<th>Table 2: Characterization of fatal vascular access hemorrhage events and documented complications within 6 months of death stratified by CVC, AIF, or AVG at the site of fatal hemorrhage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Event</td>
</tr>
<tr>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>% of total</td>
</tr>
<tr>
<td>Vascular access complications within 6 months of death</td>
</tr>
<tr>
<td>Infection 11 (7.1%)</td>
</tr>
<tr>
<td>Stenosis 5 (3.3%)</td>
</tr>
<tr>
<td>Hemodialysis access delay 7 (4.5%)</td>
</tr>
<tr>
<td>Needlestick injury 4 (2.6%)</td>
</tr>
<tr>
<td>N-Vascular access complication 3 (2.0%)</td>
</tr>
<tr>
<td>Any complication above 1 13 (8.7%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Patient location at the time of fatal hemorrhage (n=82)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
</tr>
<tr>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>% of total</td>
</tr>
<tr>
<td>Hospital 74.1%</td>
</tr>
<tr>
<td>Dialysis unit or other outpatient center</td>
</tr>
<tr>
<td>Other (car)</td>
</tr>
</tbody>
</table>
Results

• No co-relation with heparin use, medical non-compliance, illicit drug use, mental health impairment or median household income
• No definite associated comorbidity including DM, anemia, CVA except for possibly uncontrolled HTN.

Conclusion

• FVAH rare but preventable
• Proper reporting by nephrologist and medical examiners to CMS on form 2746
• Patient reinforcement of preventive measures
• Further studies to better define risk factors

Treatment options

• Endovascular
• Surgical

Aneurysms in RC AVF – 65 year old

Aneurysmal Dilatation of Dialysis Arteriovenous Access
Ravish Shah1, Tushar J. Vachharajani2 and Anil K. Agarwal1
The Open Urology & Nephrology Journal, 2013, 6, 1-5

Pseudoaneurysm

Cannulating the hemodialysis access through a stent graft – is it advisable?
Vandana Dua Niyar, Shahriar Moossaei, Tushar J. Vachharajani
Clinical Nephrology, Volume 77 - May (409 - 412), 2012
Problems with stents
- Loss of cannulation site
- Infection
- Rupture
- Health hazard for the dialysis staff
- Medico-legal concerns

Points to think -
- Stable vs. enlarging
- Universal acceptable classification of aneurysm is needed
- Monitor size at least at monthly intervals
- Document with an image at least 3-4 monthly interval
- Educate patient as rupture/accidental injury can be fatal.

Tradeoffs of upper arm AVF vs AVG
- Retrospectively identified 110 patients with forearm AVF that failed to mature, who subsequently had an AVG or upper AVF placed.
- Most were already on HD, using catheters.
- Compared multiple access outcomes between the two patient groups.

ARS question #1
- Primary failure (new access that is never usable for dialysis) is more common with:
  A. AVF
  B. AVG
  C. No difference

Primary access failures more common with AVF than AVG

Primary failure is higher for AVF than AVG (side-by-side contemporary comparisons)

<table>
<thead>
<tr>
<th>Reference</th>
<th>AVF N</th>
<th>AVG N</th>
<th>AVF Prim failure</th>
<th>AVG Prim failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maya, 2009</td>
<td>322</td>
<td>289</td>
<td>38% *</td>
<td>15%</td>
</tr>
<tr>
<td>Lok, 2013</td>
<td>1012</td>
<td>128</td>
<td>40% *</td>
<td>19%</td>
</tr>
</tbody>
</table>

Maya, CJASN 4: 86-92, 2009
Lok, CJASN 8: 810-818, 2013

AVF require more interventions to achieve access maturation

<table>
<thead>
<tr>
<th>Number of interventions</th>
<th>UA fist</th>
<th>UA graft</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>0.45</td>
<td>0.42</td>
</tr>
<tr>
<td>0.1</td>
<td>0.35</td>
<td>0.32</td>
</tr>
<tr>
<td>0.2</td>
<td>0.3</td>
<td>0.27</td>
</tr>
<tr>
<td>0.3</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>0.4</td>
<td>0.22</td>
<td>0.21</td>
</tr>
</tbody>
</table>


How often is an intervention required before access can be used for HD?

- Falk reported on 154 AVF
  - 42% required >1 interv to achieve maturation
- Lee reported on 173 AVF
  - 44% required >1 interv to achieve maturation
- Harms reported on 289 AVF and 310 AVG
  - 50% of AVF required >1 interv before use
  - 18% of AVG required >1 interv before use

Falk, JVIR 17: 807-813, 2006
Harms, 2015 NKF spring clinical meeting poster

Hurdles to achieving usable AVF in catheter-dependent patients: Fresenius

- 28,440 pts started HD in 2008
- 77% started with a catheter.
- Of pts starting with a catheter and maturing **AVF**, only 21% were catheter-free at 90 days.
- Of pts starting with a catheter and maturing **AVG**, 54% were catheter-free at 90 days.

Lacson et al, 2009 ASN free communication

ARS question #2

- Time from access creation to first successful cannulation is:
  A. Longer for AVF
  B. Longer for AVG
  C. No difference

Time to first AVF cannulation in U.S.

DOPPS:
2% cannulated within 1 month.

Months after AVF surgery

Saran, NDT 19: 2334-2340, 2004
DIALYSIS ACCESS: A FRAGILE LIFELINE

Slides

Time to first AVG cannulation in the U.S.

**DOPPS:** 78% cannulated within 1 month.

Weeks after AVG surgery

Saran, NDT 19: 2334-2340, 2004

AVF entail longer catheter dependence before their use.


Risk of bacteremia increases with duration of catheter-dependence

**First CRB:**
- 3 months: 35%
- 6 months: 54%
- 1 year: 79%

N=472


Patients with AVF have more catheter infections before access use


Outcomes of AVF vs AVG BEFORE MATURATION

<table>
<thead>
<tr>
<th></th>
<th>AVF</th>
<th>AVG</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>N patients</td>
<td>59</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>Primary failures</td>
<td>44%</td>
<td>20%</td>
<td>0.006</td>
</tr>
<tr>
<td>Interv. before maturation</td>
<td>0.42</td>
<td>0.16</td>
<td>0.04</td>
</tr>
<tr>
<td>Catheter dependence (days)</td>
<td>131</td>
<td>34</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>#CRB before maturation</td>
<td>1.33</td>
<td>0.38</td>
<td>0.003</td>
</tr>
</tbody>
</table>


Median access survival greater for AVF(excluding prim failures)

ARS question #3

- If you include primary failures (intent-to-treat analysis) access survival is:

A. Longer for AVF  
B. Longer for AVG  
C. No difference  

Cumulative survival of AVF vs AVG

- Excluding primary failures
- Including primary failures

Maya, CJASN 4: 86-92, 2009

Cumulative survival of AVF vs AVG

- Excluding primary failures
- Including primary failures

Lok, CJASN 8: 810-818, 2013

Cumulative survival of AVF vs AVG

- Excluding primary failures
- Including primary failures


ARS question #4

- Which type of access requires more frequent interventions to maintain patency for dialysis?

A. AVF  
B. AVG  
C. No difference  

Secondary survival of AVF and AVG are similar (when primary failures are included)

Cumulative survival at 1 year (Graft/fistula)

Allon, CJASN 2: 786-800, 2007
AVF require fewer interventions than AVG to maintain patency for HD

Outcomes of AVF vs AVG
AFTER MATURATION

<table>
<thead>
<tr>
<th></th>
<th>AVF</th>
<th>AVG</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>N patients</td>
<td>59</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>Median survival (excluding prim failures)</td>
<td>1524</td>
<td>517</td>
<td>0.03</td>
</tr>
<tr>
<td>Interv. per year after access maturation</td>
<td>0.73</td>
<td>2.38</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

AVG require more interventions than AVF to maintain patency for HD

What is the impact of interventions prior to maturation on access survival and frequency of interventions after use?

AVF that require interventions to achieve maturation have shorter survival.
AVF that require intervention to achieve maturation require more interventions after maturation.

- Lee et al
  - Annual frequency of AVF intervention after maturation
    - 0 interv before maturation: 0.76/yr
    - 1 interv before maturation: 1.37/yr
    - >2 interv before maturation: 3.51/yr
- Harms et al
  - Annual frequency of AVF intervention after maturation
    - 0 interv before maturation: 0.46/yr
    - >1 interv before maturation: 0.84/yr

Forearm AVG dilates prox. vein, suitable for future upper arm AVF creation

Forearm AVG before upper arm AVF:

**Pros**
- AVG mature faster (shorter CVC-dependence)
- AVG have a lower primary failure rate.
- AVG require fewer interventions before use.
- Don’t lose precious real estate.
- AVG dilate proximal veins—makes it easier to create an upper arm AVF.

**Con**
- AVG have shorter survival than AVF *
- AVG require more interventions to maintain patency for HD.
- This goes against the KDOQI vascular access guidelines.

* If you ignore AVF that fail to mature!

KDOQI vascular access guidelines: Preferred order of access type

First choice: forearm (radiocephalic) AVF
Second choice: brachiocephalic AVF

Third choice: transposed brachiobasilic fistula

Fourth choice: AVG

Forearm AVG are disappearing!

<table>
<thead>
<tr>
<th>Years</th>
<th>HD population</th>
<th># forearm AVG placed per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996-98</td>
<td>~350</td>
<td>48</td>
</tr>
<tr>
<td>2004-08</td>
<td>~500</td>
<td>12</td>
</tr>
</tbody>
</table>

Given these guidelines, how can we expect forearm AVG before upper arm AVF???

Based on preop mapping, only ~50% of patients are suitable for a forearm AVF.

What are the implications of changing the policy to recommend forearm AVG before upper arm AVF?

- The first access would be a forearm AVF in ~50% and a forearm AVG in 50% of patients.
- Among the ~50% of patients whose forearm AVF fails to mature, the second access would be a forearm AVG.
- Such a policy would greatly reduce the prevalence of AVF among HD patients, but also reduce CVC use.
- It’s time to overhaul the Fistula First guidelines!
Pros and Cons of Buttonhole Cannulation

Charmaine Lok, MD, FRCP, MSc
University of Toronto
Toronto General Hospital
National Kidney Foundation Spring Clinical Meeting 2015
Dallas, TX
March 26, 2015

History

1960
- Seattle, USA: Quinton, Dillard and Scribner
- Arteriovenous Teflon Shunt

The First Arteriovenous Fistula

The Modern Day AV Fistula

The “Gold Standard” Fistula

Dr. Lok’s patient

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**Problem: Fistula Infiltration**

- Impact of poor cannulation
  - Infiltration injury
    - Pain
    - Thrombosis
    - Salvage procedures
    - Need to rest fistula
    - Catheter dependence + associated complications
  - $8M

**Cannulation problems can be correctable**

- AKA “Constant-site cannulation”
- Described in 1977 (Hospital for Miners, Poland)

- Cannulation:
  - Same spot
  - Same angle
  - Same depth
  - EVERY TIME

**Buttonhole**

- Scar tissue tunnel tract develops

**BH Technique**

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**Buttonhole Cannulation**

*Advantages*
- ↓ Hematomas
- ↓ "Missed sticks"
- ↓ Pain
- ↓ Aneurysms
- ↓ Time
- Cosmetically better
- Potentially ↑ access survival

*Disadvantages*
- High technique failure rate (22%)
- Establishing tract
- Loose Skin
- ↑ Infections
- ↑ "oozing"
- "Trampoline effect" (painful)
- "Hubbing"
- Variable acceptance – staff dislike using someone else’s angle of insertion
- Staffing/resource challenges

*Pictures courtesy of Dr. Chris Chan*

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**Challenge #1: Developing Tract**

- Ideally should have single cannulator to establish tract
- Sharp needle 6-14 cannulations (3 months)
  - RN volunteers to work weekends, come in off-days to establish tract
  - Staff works 3 x13 hr shifts (M-W-F; T-T-S)
  - Some US centers used technicians vs RNs who work daily
  - If cannulator not available, buttonhole not used that day

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**Widening of the Buttonhole**

- Bowl-like indentation of BH entrance widens
- Called "hubbing"
- Needle hub becomes buried in the entrance of tunnel
- ↑ problems with scab removal
- ↑ risk of bleeding
- ↑ risk infection

*Figures from Twardowski, Z. JVA: 16 (Suppl 9): S54; 2015*

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**Buttonhole Infection**

- Can be very serious
- 1º organism = S. Aureus
- Metastatic
- Loss of fistula

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Buttonhole Infections: Literature

- **Doss et al., Nephrol Nurs J, 2008**
  - N=137 in combined units using buttonhole (USA)
  - 2004-2007:
    - Incentre: 10 episode of sepsis
    - 13 buttonhole infections
    - Home pts: 6 episodes of sepsis
  - Calculated infection rate=0.16/1000 (in-centre)
  - 0.19/1000 (home)
  - This is **2.75-50x greater** than using rope ladder technique!
  - Almost the same rate as CVC infection rate! (depends on centre)

More Literature

- **ESRD network 8 Region**
  - 31 facilities use buttonhole
  - 39% reported complications
  - 40% reported infections

- **14 ESRD networks examined (questionnaire)**
  - Comprises 510 facilities
  - BH techniques used 1-40/institution
  - 11.1% infections

Serious infections:
- Septic arthritis, osteomyelitis, epidural abscess, endocarditis, sepsis requiring ICU stay, death

Comparison BH vs Step Ladder

- **Van Loon et al., NDT, 2010**
  - Prospective, observational study (n=75 BH; n=70 SL)

<table>
<thead>
<tr>
<th>Factors</th>
<th>BH</th>
<th>SL</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unsuccessful cannulation (avg)</td>
<td>8.1</td>
<td>3.7</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Aneurysm</td>
<td>1%</td>
<td>67%</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Pain (scale)</td>
<td>More (1.6)</td>
<td>1.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Fear (scale)</td>
<td>More (0.63)</td>
<td>0.38</td>
<td>&lt;0.002</td>
</tr>
<tr>
<td>Infections</td>
<td>7</td>
<td>0</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Evidence Pyramid

RCT: Standard needle (SN) vs BH Cannulation

- **MacRae, J et al.; CJASN; 2012; 7; 1632-1638**
  - Primary Objective:
    - To determine if, after 8 weeks of buttonhole creation, there was a difference in perceived pain at time of needling
    - 10 cm VAS
  - Secondary Objective:
    - Collect information on hematoma formation, time to hemostasis, risk of AVF infection, nursing perceived difficulty in needling

<table>
<thead>
<tr>
<th>SN (60)</th>
<th>BH (60)</th>
<th>Problem free AVF *4 weeks Conventional 3x/wk HD (n=140)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>F</td>
<td>Single Centre</td>
</tr>
</tbody>
</table>

Results

- Within study period proper: 1 episode of *S. aureus* bacteremia (BH)
- Within 12 mos follow-up: 2 *S. aureus* bacteremias, 9 abscesses requiring IV antibiotics (BH)
- No infectious events in SN group

Increasing difficulty needling in BH group (20/69) vs SN group (6/69); p=0.002
Other RCTs

A RANDOMISED CONTROLLED TRIAL OF BUTTONHOLE CANNULATION FOR THE PREVENTION OF FISTULA ACCESS COMPLICATIONS


Grudzinski, A. et al, Semin Dial; 26(4); 265, 2013

- Included observational studies and RCTs
- Home and in-centre hemodialysis
- Infection rate: x/1000 AVF days

<table>
<thead>
<tr>
<th>Type of Infection</th>
<th>Home HD</th>
<th>In-centre HD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systemic</td>
<td>0.00-0.28</td>
<td>0.00-0.43</td>
</tr>
<tr>
<td>Local</td>
<td>0.00-0.18</td>
<td>0.13-1.93</td>
</tr>
</tbody>
</table>

"shorter term studies may underestimate infection risk with BH technique"

- Complications: septic arthritis, septic pulmonary emboli, vertebral osteomyelitis (quadriplegia), death (Home HD)
- Paravertebral abscess-resolved (in-centre HD)

Systematic Reviews: Infections

Better with Self Cannulators?

Self Cannulate - potential for better tract and less injury
Self Cannulators usually in home setting - more frequent dialysis...? More injury?

Comparisons in NHD

![Figure 1: Time to first septic permanent access event in conventional hemodialysis vs. buttonhole hemodialysis (BH technique).](image)

Beware of Infectious Complications

- Lok, C. et al, Nephron Extra; 4; 159, 2014
- Frequent Dialysis Population
- SDH=46; NHHD=128 (Ottawa + Toronto)

Complications:
- 39 button-hole related bacteremia
- Rate=0.196/1000 access days
- 85%

Using rope-ladder technique in CHD
UHN: Jan 1 2000-Dec 31 2010: 623,411 fistula days
Rate for fistula infection=0.002/1000 days

Should Buttonhole Cannulation Be Discontinued?

- Lok, C. et al, Nephron Extra; 4; 159, 2014
- 39 button-hole related bacteremia
- Rate=0.196/1000 access days
- 85%
Vascular Access Use in Frequent HD

- The optimal access for home and intensive in center dialysis is yet to be identified.
- The risks and benefits with button-hole cannulation remain uncertain.
- "A mature fistula is still the best option for frequent dialysis patients, but consider avoiding button-hole cannulation" 

Infection Prevention

- Meticulous antisepsis + 3 key factors
  1. Wear a mask
  1. Avoid cannulation mishaps/hubbing
  1. Antibiotic ointment prophylaxis

Improving BH-related infections

Birechenough et al., Nephrol Nurs J, 2010
- Evaluated fistula infection rates over 13 months prior to QA initiative
- Baseline rate of infections:
  - Step ladder technique: 4.9%
  - BH technique: 52.0%
- After educational/QA intervention (revised P&P):
  - Infection with BH technique: ↓ 29.8%

Pierratos’ group (CJASN, 2010): SA bacteremia
- CHD pts with SL technique: rate=0.005/1000
- NHD with BH (n=56): 0.32/1000 = 64x greater
- Mupirocin to BH: 0.03/1000 = 6x greater

Systematic Reviews: Aneurysms

Grudzinski, A. et al, Semin Dial; 26(4); 265, 2013

<table>
<thead>
<tr>
<th>Author</th>
<th>Buttonhole</th>
<th>Rope Ladder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Van Loon</td>
<td>1%</td>
<td>67%</td>
</tr>
<tr>
<td>Hashmi</td>
<td>12%</td>
<td>24%</td>
</tr>
<tr>
<td>Pergolotti</td>
<td>20%</td>
<td>46%</td>
</tr>
</tbody>
</table>

Marticorena et al noted regression of aneurysmal dilatation.

Access Survival

Vaux et al. AJKD; 62(1); 2013

RCT: 70 each group; 58 BH (BioHole Stick) and 69 RL analyzed

12 month follow up

Fewer interventions required
Access Survival: Assisted Patency
- RCT: MacRae, J et al.; 2012; 7; 1632-1638

AVF Survival: Unassisted Patency
- RCT: MacRae, J et al.; 2012; 7; 1632-1638

BH vs Rope Ladder:
**Long Term outcomes**

<table>
<thead>
<tr>
<th>Table 2. Primary and Secondary Outcomes Using Intention-to-Treatment Analysis</th>
<th>Standard (n = 80)</th>
<th>Buttonhole (n = 78)</th>
<th>BH (n = 81)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thrombosis rate</td>
<td>0.05 [0.04-0.11]</td>
<td>0.04 [0.02-0.08]</td>
<td>0.05 [0.04-0.11]</td>
</tr>
<tr>
<td>Re-ligation rate</td>
<td>0.75 [0.5-1.11]</td>
<td>0.89 [0.6-1.2]</td>
<td>1.26 [0.8-2.0]</td>
</tr>
<tr>
<td>PTA rate</td>
<td>0.75 [0.6-1.46]</td>
<td>0.86 [0.6-1.41]</td>
<td>1.26 [0.74-1.80]</td>
</tr>
<tr>
<td>Surgical intervention use</td>
<td>0.11 [0.08-0.21]</td>
<td>0.08 [0.04-0.14]</td>
<td>0.10 [0.03-0.18]</td>
</tr>
<tr>
<td>Total infections</td>
<td>0</td>
<td>12</td>
<td>63.20 [27.2-100.0]</td>
</tr>
<tr>
<td>Localized site</td>
<td>2</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>2 Localized sites</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Patients followed from July 2006 to July 2013

What do patients think?
- Variable in literature
- Galante et al, J Ren Care, 2010
- Prospectively followed patients who initiated BH
  - 50% preferred BH
  - 6.25% preferred SL
  - 43.7% indifferent
- Ease of cannulation was NOT perceived as an advantage
- Reduced pain was the main advantage for patients
- Nurses noted significant reduction in hematoma

Hope

Original Investigation

Buttonhole: Indications
- Limited cannulation length/site
- Aneurysmal AVF
- Painful cannulation
- Want to preserve damaged AVF
- Self care or Home HD in a reliable patient or home cannulator
Nice Buttonhole Cannulation Sites!

What we want: Good Cannulation

Summary

- Buttonhole cannulation is an important cannulation option
- BH cannulation is associated with an increase in infections
- BH cannulation is associated with less aneurysm formation (short term)
- BH cannulation does not appear to improve fistula survival
- Careful selection of patients are required for BH cannulation and should be performed only when the stepladder technique is not possible

THANK YOU!

Questions?