Buttonhole: The Evidence and How to Implement

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October 1, 2014
Aarhus, Denmark
Several older studies reveal access longevity compares favorably to conventional HD possibly due to:

- Better blood pressure control
- Less hemoconcentration
- Improvement of uremic thrombopathy
- Reduced episodes of hypotension
- Single-person cannulation and self-cannulation

Kjellstrand & Ting. 1998.
Lindsay et al. 2001.
Quintaliani et al. 2000.
Twardoski. 1996
Kenley R. 1996.
<table>
<thead>
<tr>
<th>Year</th>
<th>Education</th>
<th>Research</th>
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</thead>
<tbody>
<tr>
<td>2005</td>
<td>Ball</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>Ball</td>
<td>Marticorena et al.</td>
</tr>
<tr>
<td>2007</td>
<td>Ball et al.</td>
<td>Verhallen et al.</td>
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<td>2008</td>
<td>Doss et al.</td>
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<td>2009</td>
<td></td>
<td>Marticorena et al.; van Loon et al.</td>
</tr>
<tr>
<td>2010</td>
<td>Ball &amp; Mott; van Eps et al.; Birchenough et al.; Ball</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td></td>
<td>Vaux et al.</td>
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</tbody>
</table>
More Recent Study Outcomes

- Pain is generally less, particularly when done by patient
- Hematoma formulation is less
- Unsuccessful cannulation is generally higher, particularly with staff
- No negative impact on access longevity or aneurysm complications has been demonstrated
- Infection rates are higher
Research

There have been 23 studies, including 5 RCTs where a comparison to rope ladder technique was made.

| Cannulation Pain | 14 studies; 5 RCTs | 1 RTC decreased pain  
| Access intervention | 7 studies; 2 RCTs | 3 RTCs no statistical difference  
| Access survival | 3 studies; 2 RCTs | 1 RTC increased pain  
| Aneurysm | 4 studies | 1 study; 1 RCT reduction in interventions  
| | | 1 RCT more fistulograms  
| | | Others no difference  
| | | 1 RCT 100% survival  
| | | 1 RCT similar survival w/rope ladder  
| | | 1 study no difference  
| | | Trend indicates longer survival with BH  
| | | 4 benefited, 3 statistically demonstrated |
## Less Mechanical Complications with Buttonhole in 3x/wk Dialysis

![Table](image)

<table>
<thead>
<tr>
<th></th>
<th>Rope-ladder (n = 70)</th>
<th>Buttonhole (n = 75)</th>
<th>P-value</th>
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<tbody>
<tr>
<td>Patients with diagnostic tests</td>
<td>28</td>
<td>15</td>
<td>0.004</td>
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<tr>
<td>Diagnostic tests</td>
<td>73</td>
<td>24</td>
<td></td>
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<td>Duplex</td>
<td>14</td>
<td>11</td>
<td></td>
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<td>Fistulogram</td>
<td>51</td>
<td>10</td>
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<td>MRA</td>
<td>8</td>
<td>3</td>
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<td>Patients with interventions</td>
<td>21</td>
<td>6</td>
<td>0.001</td>
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<tr>
<td>Interventions</td>
<td>41</td>
<td>10</td>
<td></td>
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<tr>
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<td>35</td>
<td>2</td>
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<tr>
<td>Thrombectomy</td>
<td>3</td>
<td>1</td>
<td>0.81</td>
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<td>Surgical revisions</td>
<td>3</td>
<td>3</td>
<td>0.55</td>
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<tr>
<td>Antibiotic treatments because of access-related infections</td>
<td>–</td>
<td>4</td>
<td>0.001</td>
</tr>
</tbody>
</table>

van Loon et al., 2010
In-center Buttonhole by RNs

Less hematomas, but more localized infections

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Standard Needling Rate per 1000 Dialysis Sessions</th>
<th>Buttonhole Needling Rate per 1000 Dialysis Sessions</th>
<th>P Value</th>
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</thead>
<tbody>
<tr>
<td>Hematoma formation</td>
<td>436</td>
<td>295</td>
<td>0.003</td>
</tr>
<tr>
<td>Bleeding postdialysis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No bleeding</td>
<td>23.6</td>
<td>28.3</td>
<td></td>
</tr>
<tr>
<td>Any bleeding</td>
<td>97.6</td>
<td>97.2</td>
<td>0.40</td>
</tr>
<tr>
<td>Signs of localized infection</td>
<td>22.4</td>
<td>50.0</td>
<td>0.003</td>
</tr>
</tbody>
</table>

Signs of localized infection included erythema, pus, or swelling at the fistula site.

McRae et al., 2012
Hematoma Formation Less

Van Loon et al., 2010
Aneurysm Formation Less

Van Loon et al., 2010
Nurses Had More Trouble with Buttonholes

McRae et al., 2012
Difficulty with Cannulation by Staff

van Loon et al., 2010
Risk of Infection with Buttonhole

0.43 episodes/1000 patient days (0.17 prior; Staff)

0.29 episodes/1000 patient days (Patients)

0.31 episodes/1000 patient days (Staff)

0.50 episodes/1000 patient days (0.22 with conventional: Staff)

Risk of either local infection, bacteremia, or distant infection is approximately 11% per year whether cannulation is done by staff or patients.

McRae et al., 2011
Nesrallah et al., 2010
van Loon et al., 2010
Zimmerman & Lok, 2012
Mitigating Risk of Infection with Buttonhole

0.43 episodes/1000 patient days (0.17 prior; Staff)
  Staff workshops and education
0.34 episodes/1000 patient days

0.29 episodes/1000 patient days (Patients)
  Patient education and mupuricin
0.003 episodes/1000 patient days

McRae et al., 2011
Nesrallah et al., 2010
Why offer the Buttonhole Technique?

- Prolongs AV fistula life
- Fewer missed needle sticks, infiltrations, and hematomas\(^1\)
- Less painful – elimination of anesthetics\(^1\)
- Reduces bleeding time at the end of treatment \(^2\)
- Decreases number of angioplasties\(^3\)
- Promotes patient self-cannulation
- Eliminates aneurysm formation

\(^{1}\)Twardowski, 1995; \(^{2}\)Ball et al., 2007; \(^{3}\)Van Loon et al., 2009
Suitable Candidates

Patients with AV Fistulas:
- Short segment fistula
- Difficult to cannulate
- Needle fear/phobia
- “One-site-itis”
- Repeated infiltrations
- Self-cannulation
High Risk Candidates?

- Heart valve disease
- History of endocarditis
- Patients with chronic infection
- Immunocompromised
- Thin skin
  - steroid use
  - elderly fragile skin
  - diabetes
- Patients who pick scabs

Marticorena et al., 2006; Verhallen et al., 2007; Sutherland & Mills 2010
Will the Patient Self Cannulate?

- Look at the patient’s angle of insertion.
- Look at your angle of insertion.
- You will need to readjust your angle by swinging the patient’s arm out.

Source: L. Ball
Buttonhole Technique

- Reuse same sites each treatment
- Scab removal
- Must follow the tunnel of the original cannulator
- Use blunt needles
- 2-Point Technique
- For AVFs only

Source: L. Ball
Angle of Entry

- It is **not** 25 degrees for every fistula
- The angle of entry is based on the depth of the AVF
- Assess the fistula with a tourniquet on, and feel how deep below the surface of the skin the access is
- Before cannulating an AVF, you should already know the angle of insertion

\[ \text{Angle of Entry: } 20^\circ \text{ to } 35^\circ \]
2-Point Stretching Technique

- Anchors the vein to prevent the doorway into the blood vessel from moving
- Compresses nerve endings decreasing pain during creation
- Stretching from side to side maintains the integrity of the tunnel
Buttonhole Tunnel

• Tissue is removed with repeated sharp needle cannulation
• Epithelial cells migrate from skin surface to form the smooth tunnel wall
• Formation is similar to a pierced earring hole formation
• Lining is thin and easily punctured with needle tip when pushing too hard

Source: Tony Goovaerts
Buttonhole Blood Vessel Wall

Photo courtesy of Dr. S. Toma
Needles – sharp and blunt

Photos: Lynda Ball
Changing to Blunt Needles

• This will be individual to each patient, but look for these things:
  ➢ Can you visualize a round hole?
  ➢ Does it look well-healed?
  ➢ Is there a decrease in resistance from day-to-day?

• Do not use excessive force when changing to blunt needles – you’re not in the correct position
A Developing Buttonhole Site

- Buttonhole hole is starting to develop
- Site well healed, no redness or drainage
- Still slight resistance with needle insertion
- This site is not yet ready for a blunt needle

Photo: Lynda Ball
Cannulation

• **For mature AVFs:** Chose a needle size for the blood pump speed ordered (e.g., BFR >350 to 450 mL/min use a 15 gauge needle)

• **For new AVFs:** Start with a 17 gauge needle and proceed through the gauge sizes, until you reach the needle size ordered by MD.

• **Sharp needle and blunt needle sizes must be the same**
Buttonholing Issues

• If a site is not progressing, it is ok to abandon that site and find another site

• Bleeding can occur around the needles during dialysis if:
  ➢ Using sharp needles and have cut the track
  ➢ Track punctured/damaged from directing/pushing the needle instead of following the track
Buttonholing Issues

• Continuous pain – insertion, dialysis, needle removal?
  ~Nerve innervation from swelling in tissue surrounding buttonhole tunnel
  ~Develop a new tunnel – if pain continues, change to site rotation cannulation

• If you have blood flow or pressure problems:
  ~Have you changed needle direction during cannulation?
  ~Have you taped the needle too tightly?
  ~Did you forget to prop a steeper-angled needle?
Buttonholing Issues

Left vs. Right Handedness?
• The position of insertion is different
• Take a picture of the needle insertion
  o Shows correct angles
  o Shows position over top of the access
• Adjust the patient’s arm and the angles of entry into the access will line up
Hospitalization, Special Procedures, or Traveling

- Tunnels can be ruined if healthcare professionals are unfamiliar with the Buttonhole Technique.
- If your patient is hospitalized, having a procedure, or traveling and the professional does not know how to access a buttonhole:
  - Rotate sites using sharp needles
  - Protect the tunnel – use a 2-finger hold position
Aneurysms in Buttonholes

- Using sharps in the buttonhole when unable to advance the blunt needles – results in a small area being cannulated
- Weakens vessel wall and pressure of blood flow pushes weakened area out – this will not occur at the buttonhole site, but at the vessel flap site
Use of Sharp Needles

✓ Once you transition to blunt needles you NEVER go back to a sharp needle down the tunnel

✓ We now know that using sharps long-term is causing scarring to the tunnel, and should therefore be discouraged – use Best Demonstrated Practices
Infections and What to do About Them
Colonization of Exit Sites

• *Staphylococcus aureus*

Source: CDC/Matt Arduino
Patient’s Role in Infection Prevention

- Patient should wash their access with soap & water before coming to their chair
- Dialysis patients have more staph on skin than the general population
- Staph is the leading cause of infection in dialysis patients (CDC)
- Staph is the 2nd leading cause of death in dialysis

Importance of Washing Your Access
Lynda K. Ball
Infection: Exit Site

Localized

- Improper skin cleansing
- Improper scab removal

OBSERVE
SCAB SIZE

Best Demonstrated Practice

2-Step Skin Cleaning Protocol for the Buttonhole Technique

• Patient must wash their arm immediately before the sitting down
• **Step 1:** Cleanse the needle sites prior to scab removal with an antimicrobial agent
• Remove the scabs
• **Step 2:** Re-prep the needle sites with an antimicrobial agent, and let dry
• Cannulate
## Skin Preparation

### Rule of 3’s

<table>
<thead>
<tr>
<th>Cleansing Agent</th>
<th>Contact Time</th>
<th>Cannulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Betadine®</td>
<td>3 minutes</td>
<td>When dry</td>
</tr>
<tr>
<td>ChloraPrep®</td>
<td>30 seconds</td>
<td>When dry</td>
</tr>
<tr>
<td>Alcohol</td>
<td>30 seconds</td>
<td>When dry</td>
</tr>
</tbody>
</table>

Source: L. Ball
Removing the Scab

- The Buttonhole Technique requires complete removal of the scab before cannulating.
- Moistening the scabs makes them easier to remove.
- Scab removal should occur just before needle placement – never have the patient remove scabs before they get to dialysis.
Do’s and Don’ts of Scab Removal

- Don’t flip the scab off with the needle you will use for cannulation
- Don’t use a sterile sharp needle
- Don’t let patients pick off their scabs with their finger nails
- Don’t stick through scabs
- Don’t use any reusable items to remove scabs (i.e., facial sponges, bath scrubbies)
- Don’t dig out scabs

- Moisten scabs first:
  ~soak gauze with NS or alcohol-based gel
  ~place a warm, moist washcloth over sites
  ~have patient tape alcohol squares over sites prior to dialysis

- Do use after moistening, while stretching the skin:
  ~scab-lifting device
  ~single-use tweezers
Proper Use of Scab-Lifting Devices

Lift a corner

Scoop – like ice cream

Never dig like you’re using a shovel – you can cause an exit site infection!
Infection: Tunnel/Systemic

• Contaminated needle
• Improper cannulation of the track

OBSERVE SCAB SIZE

Not following the originator’s angle of entry.

Not holding the skin taut every cannulation

Creates pockets that can allow bacteria and blood to collect, which can cause a tunnel infection.
Hubbing - What’s This?

- Creates a cave-like entranceway of buttonhole exit site
  - Inability to remove scab completely
  - Could contaminate the needle if you touch any area that couldn’t be cleaned

Preventing “Hubbing”

• Leave space between the hub and the skin to prevent the bowl effect called “hubbing”

• Have approximately 1/8” of the needle showing

The Buttonhole Technique does not cause accesses to clot

Clots form because staff are not using the 2-finger hold technique when removing needles

The tunnel then has a complete clot that forms and is very hard to remove

You can push it into the circulation

The blood pump can pull the clot into the arterial tubing where it lodges in the header of the dialyzer, which could affect adequacy

Clots can harbor bacteria, increasing risk for infection
• Not only do dialysis patients have more staph on their skin, but they have more in their nares (noses) than the general population.¹

• If you have staph in your nose, just breathing on the access site may be a source of infection.

• Infections in buttonhole sites is the same infections with catheters: exit site, tunnel, blood stream, distant

Kaplowitz, et al., 1988
Wearing a Mask

RIGHT

WRONG
Topical Antimicrobial Use?

The Debate…

Yes – Use

• Prevent colonization of the tunnel?

• Prevent exit site infections?

No – Don’t Use

• Cause resistant organisms?

The Buttonhole Research…


Available agents:
• Mupirocin
• Triple antibiotic ointment
• Gentamycin cream
Patients should NOT:

• Swim with buttonhole sites unless a waterproof dressing is used and stays intact
• Use a hot tub – bacterial contamination could occur
• Remove scabs at home – they should be removed just before cannulation
• Use bath scrubbies or facial sponges – the porous materials could grow bacteria
• Pick scabs off with their fingernails
Alternative Buttonhole Site Creation Techniques: Are They Effective?
BioHole™ Peg

Source: S. Toma
Inserting BioHole into Skin
BioHole in the Patient’s Arm

Source: Nipro
Cannulation After 14 Days
Reported Pain with BioHole Creation vs. Freehand BH

ButtonHole technique
Puncture pain compared to conventional method

- No pain experienced: 40.5%
- Less pain experienced: 40.5%
- Pain equivalent: 19%
ClampCath Catheter
VWING Device

- It is a titanium funnel with a palpable ridge.
- The AVF needs to be 5mm in diameter.
- It is used for deep upper arm accesses deemed uncannulatable.
- It is initially sewn onto the top of the AVF, but grows into vessel wall.
- It takes three weeks to heal, but still reduces catheter exposure time.

Source: Vital Access
Unguided vs. Guided Buttonhole Creation

Source: Vital Access
Freehand vs. VWING
Buttonhole Creation

Source: Vital Access
## VWING Adverse Events

### SAVE Trial

<table>
<thead>
<tr>
<th></th>
<th>Subjects</th>
<th>Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enrolled/Implanted</td>
<td>54</td>
<td>82</td>
</tr>
<tr>
<td>Study/Device Days</td>
<td>9,497</td>
<td>14,172</td>
</tr>
<tr>
<td>Successful fistula access through a VWING</td>
<td>96%</td>
<td>95%</td>
</tr>
<tr>
<td>Using VWING at 6 months</td>
<td>94%</td>
<td>92%</td>
</tr>
</tbody>
</table>

Table 1: SAVE Trial Efficacy Results

<table>
<thead>
<tr>
<th>Event</th>
<th># of events (% of subjects)</th>
<th>Rate per patient year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cannulation pain leading to device removal</td>
<td>2 (3.7%)</td>
<td>0.08</td>
</tr>
<tr>
<td>Stenosis at the VWING</td>
<td>3 (5.6%)</td>
<td>0.11</td>
</tr>
<tr>
<td>Inability to cannulate leading to device removal</td>
<td>2 (3.7%)</td>
<td>0.08</td>
</tr>
<tr>
<td>Sepsis</td>
<td>1 (1.9%)</td>
<td>0.04</td>
</tr>
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</table>

Table 2: Summary of serious VWING or procedure related adverse events

Source: Vital Access
## VWING 18-Month Follow-Up

<table>
<thead>
<tr>
<th>Clinical Outcome</th>
<th>Results</th>
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<tbody>
<tr>
<td><strong>Systemic Infection</strong></td>
<td>0.05/1000 patient days</td>
</tr>
<tr>
<td><strong>Access Intervention</strong></td>
<td>0.8 interventions per patient year (n=50)</td>
</tr>
<tr>
<td><strong>Access Survival</strong></td>
<td>100% secondary patency at 6 months (n=50) 91% secondary patency at 18 months (n=34)</td>
</tr>
<tr>
<td><strong>Aneurysm</strong></td>
<td>0 aneurysm at median follow-up of 18 months (n=34)</td>
</tr>
</tbody>
</table>
In Summary…It’s ALL in the Details

✔ Buttonhole Technique is an effective method of needle insertion when done correctly.

✔ Good assessment skills, meticulous cleaning, and attention to detail will result in long-term buttonhole sites without complications.

✔ It is necessary to review your cannulation practice, and eliminate poor technique.

✔ Standardization of cannulation technique is necessary; periodic competency reviews and direct observation should be mandatory.


Questions?

For more information:
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Resources:
www.fistulafirst.org (Change Concept #8)
http://www.nwrenalnetwork.org/fist1st/ffcannu.htm
http://www.nwrenalnetwork.org/fist1st/
    ButtonholeBrochureForPatients1.pdf
www.5diamondpatientsafety.org
( Constant Site Module)