

The Buttonhole Technique for Arteriovenous Fistula Cannulation

Lynda K. Ball

In the United States, the rope ladder and site rotation techniques are commonly utilized for the cannulation of arteriovenous fistulae (AVFs). Almost 30 years ago in Europe and Japan, and 25 years ago in Seattle, Washington another technique for cannulating AV fistulae was started – the buttonhole technique.

The buttonhole technique is now widely supported and used in the Pacific Northwest and, from communications with patient care staff from around the country and Canada, it is evident that the use of this technique is spreading. This article will describe buttonhole cannulation and provide patient care staff with troubleshooting techniques as they add the buttonhole technique to their vascular access programs and potentially increase the number of patients utilizing the technique.

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The buttonhole technique began 30 years ago in Europe and Japan, and 25 years ago in Seattle, Washington. Some believe its failure to “catch on” in the United States is due to the graft culture of the last 20 years. Now with an increase of AV fistulae, this technique is becoming known as a viable cannulation option. The purpose of this article is to provide technical information for nephrology nurses performing this technique.

Goal

To provide an evidence-based educational tool for nephrology nurses to enable them to perform and troubleshoot the buttonhole cannulation technique for accessing an arteriovenous fistula.

Objectives

1. Identify at least one barrier that may preclude a patient from utilizing the buttonhole technique.
2. List two patient benefits for the buttonhole technique.
3. Explain the changes that indicate readiness to switch from sharp needles to blunt needles.

Dispelling the Myths

There have been many inquiries about who is or is not a candidate for this technique. There are some physicians who think the technique is only for those patients with limited length accesses. The first published articles were from Dr. Twardowski and colleagues (in 1977 in the Polish literature and in 1979 in the United States) where they indicated that buttonhole technique was first used on a patient with a very limited access (Twardowski, Lebek, & Kubara, 1977; Twardowski & Kubara, 1979). Observations of this patient showed decreased pain associated with cannulation, less time required for needle insertion, and no complications. Eventually, all of the patients in that unit utilized this technique.

Some believe that buttonhole is

only for the home hemodialysis population and is not to be used in the in-center setting. Having an access with the fewest cannulation issues or complications is ideal for the home hemodialysis patient, but it is also ideal for the in-center population. Besides, in the event that a home patient requires in-center treatment or a unit accepts transient patients, it is important to have staff with knowledge on how to cannulate and/or care for buttonholes.

Still others believe that buttonholes can only be used on brand new AVFs. New AVFs are pristine, not yet having developed scarring, aneurysms or hematomas that may add to the challenge of a successful cannulation procedure. In the Pacific Northwest, there are accesses that range from several months to decades old being can-

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nulated using the buttonhole technique very successfully. A thorough assessment should be completed to evaluate any potential problems an access may possess.

Probably the biggest fear with this technique is whether aneurysm formation occurs from cannulating in the same spot time and time again. In 1984, Dr. Kronung compared the rope ladder, area puncture, and buttonhole techniques and found that the area puncture technique caused the greatest aneurysm formation and the buttonhole technique showed no aneurysm formation (Kronung, 1984). The Northwest Renal Network has published a patient flyer in English, Spanish, and Russian entitled *Using the Buttonhole Technique for Your AV Fistula* (Ball, 2004) that is set in a question-answer format to help patients understand that aneurysm formation results from inserting needles into the same general area (area puncture) of the fistula, allowing the vessel wall to weaken and balloon out. When cannulating in the same identical spot over and over, there is no weakening of the wall, hence no aneurysm formation. At a conference in 2005, Tony Goovaerts, an RN from Belgium, presented ultrasounds of buttonholes and Dr. Toma from Japan presented an excision of a buttonhole site from a deceased patient, both reporting there was no aneurysm formation from this technique (Goovaerts, 2005; Toma, 2005). Also, observational reporting from facilities across the United States and Canada indicates no aneurysm development has been noted to date (Ball, 2005b).

Patient Benefits of the Buttonhole Technique

In order for a cannulation technique to be of value, it needs to benefit the patient's fistula, be a benefit to the patient care staff, but most importantly benefit the patient overall. Twardowski and Kubara (1979) compared site rotation and constant site (buttonhole) needle insertion and

found that fistula failure using site rotation was a result of hematoma formation and that this did not occur with the buttonhole. They identified that the buttonhole had a 10-fold reduction in hematomas, and that cannulation took much less time than with site rotation.

For patient care staff, cannulation time is decreased with the buttonhole. There is no need to identify new sites, there are fewer missed sticks and infiltrations, and no hematoma formation at the insertion sites. In other words, the potential complications associated with cannulation are decreased and/or are eliminated, causing overall time for cannulation to be decreased. Another plus is that patients can self-cannulate, which allows more independence for the patients and more available patient care time for the staff for challenging accesses.

The overall benefits to patients of the buttonhole technique are that cannulation is less painful (Goovaerts, 2005; Toma, 2005; Twardowski & Kubara, 1979), allowing patients to eliminate the use of anesthetics; the needles are easier to insert into the track; and patients can use blunt needles that reduce the cutting of the tunnel and subsequent oozing during dialysis. Over the course of the London Daily/Nocturnal Hemodialysis Study (Lindsay, Leitch, Heidenheim, & Kortas, 2003), patients preferred the buttonhole technique because of decreased pain, speed, and ease of cannulation.

Barriers to Buttonhole

One of the biggest barriers to the buttonhole technique has nothing to do with patients; rather, it has everything to do with staffing patterns. The ideal staffing pattern would have staff working every Monday-Wednesday-Friday or Tuesday-Thursday-Saturday, but in reality staffs work a variety of shifts and hours (part time, per diem, 8-hour, 10-hour, and 12-hour shifts) that make it unlikely that the same person is with the patient on a regular basis. It is strongly recommended that the same

person create the tunnel, which takes anywhere from 3 to 4 weeks to form (Ball, 2005b). Cannulation is a very individualized process as each clinician chooses the angle of insertion based on their independent assessment of the depth of the access. Because of this, two different individuals may determine the angle of entry to be slightly different. The result will be a tunnel that will not have the same shape as the needle and will result in oozing when the patient is heparinized.

Barriers need to be thought of as challenges to the technique rather than reasons to exclude patients from using the technique. One of the biggest barriers is the amount of scar tissue over the patient's fistula. Scarring can occur for many different reasons: multiple problematic needle sticks, lidocaine use, keloid formation, or long-lived AVFs. Cannulators know how difficult it is to place needles correctly through tough scar tissue without the access moving beneath their fingers.

The other major barrier to buttonholes is an upper arm with large amounts of subcutaneous or adipose tissue or one with excessive skin due to loss of muscle mass or weight. This tissue is not stable or firm, making it very difficult to cannulate the access beneath it. One suggestion would be to have the patient hold the skin in the same position over the access for each cannulation. Buttonhole tunnels need to be straight – if there is no way to keep the skin stable to create a straight tunnel, then the buttonhole technique will not work for that individual.

Because of these barriers, you might identify these patients as ones who could greatly benefit from this technique, and they can, but know that it will take patience and perseverance by both staff and patients for the technique to be successful.

Differences Between Site Rotation and Buttonhole Cannulation

There are three major differences between site rotation and buttonhole

cannulation – individualization of cannulation, scab removal, and who can cannulate.

Individualization of Cannulation

The first difference has already been addressed – individualization of cannulation. As a cannulator, you evaluate and determine the angle of entry you will use for each site. However, when it comes to a buttonhole site, the originator of the tunnel has established the angle of entry. It is very difficult to change that mind-set and give up that independence, especially if the angle is different than the cannulator would have chosen. The main point is that it is not about the cannulator and what they would have done, but rather what the originator has done and now must be followed. It would be very convenient if we could use just one angle of entry for all AVFs, but until all surgeons are creating all AVFs within 6 mm of the surface of the skin, it's not practical and we will fail at cannulation unless we use our assessment skills to determine depth of the access.

Each needle site will probably have a different angle of insertion. The originator of the buttonhole should either take a photo of the insertion angle, have direct discussion with the next cannulator, or write a note on the care plan indicating the angle of insertion. Communication is the key to successful buttonhole cannulation.

Scab Removal

The second major difference has to do with the scabs. In site rotation, you always look for prior scabs to indicate where the last puncture sites were so you can avoid them. But with the buttonhole technique, you need to look for those scabs and remove them in order to insert the needles into those same holes.

How should scabs be removed? Having many conversations with patient care staff all across the country, there are several different ways being used, both good and bad, to remove scabs (see Table 1). First and

Table 1
Do's and Don'ts of Scab Removal

- Don't** flip the scab off with the needle you will use for cannulation – this contaminates the needle.
- Don't** use a sterile needle – you could cut the patient's skin and break the scab into little pieces.
- Don't** let the patient remove their scabs with their fingernails.
- Do** use either:
 - aseptic tweezers;
 - soak 2 x 2s with sterile saline and lay over the scab;
 - moisten 2 x 2s with alcohol-based gel; or
 - tape an alcohol wipe over sites prior to dialysis

foremost, we have to adhere to proven infection control methods with regard to sterile needles. Flipping scabs off with the tip of the sterile needle you are going to insert is not appropriate. The skin of patients on dialysis has been shown to have more *Staphylococcus aureus* on it than the skin of the general population of individuals. It stands to reason that a scab, with all its nooks and crannies, will have a lot of *Staphylococcus aureus* "hiding" there as well. This should lead you to the logical conclusion that the scab should be removed prior to the skin being prepped. The next thing that should touch the skin after prepping should be the sterile needle.

Another way staff have suggested to remove the scabs is by using a separate sterile needle. That can be done, but you risk cutting the patient's skin while you are removing the scab. There is also the risk of fragmenting the scab and then having to remove the remaining piece(s). You also would need to have a sharps container available to dispose of the needle. One of the advantages of the buttonhole technique is that the blunt needle is classified as a safe needle device and, therefore, reduces the risk of needle sticks. Using a sterile needle would nullify the safety aspect of the buttonhole technique.

A third area that should be avoided is allowing patients to remove their scabs with their fingernails. There is research to suggest that

microbes remain present in the sub-ungual area (base) of the nail even after hand washing (Centers for Disease Control, 2002). In addition, patient hygiene has been identified as a potential cause of some vascular access infections (Arduino & Tokars, 2005).

Soaking the scabs make them easier to remove. This can be done by several different methods. Most facilities have 2 x 2s that they use after needle removal to stop bleeding at the needle sites. Draw up some normal saline from the bag you are priming the system with and squirt the saline onto two 2 x 2s and place them over the scabs while you are completing the patient assessment. Then pinch the 2 x 2s with your thumb and forefinger and pull the scab off, turning the 2 x 2 over to make sure you got the entire scab, and then you are ready to prep the sites. If you use alcohol-based gels in your facility, you could use that in place of normal saline.

One of the most ingenious methods of scab removal came from a facility in Oregon, where they send the patients home with a roll of tape and some alcohol squares. They instruct the patients to open the alcohol squares and place over the scabs, securing with the tape prior to coming to dialysis. By the time the patients arrives at the unit, the scabs are moist and ready for prepping when the patients sit down in their chairs.

Figure 1
Creation of a Buttonhole – Day 5

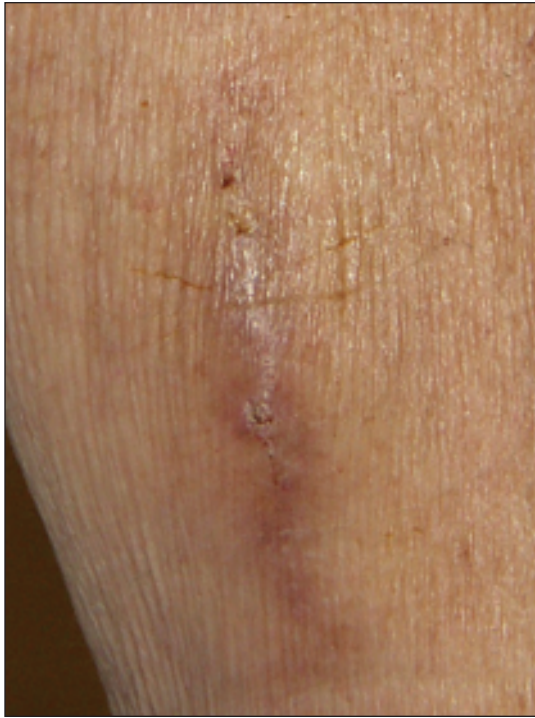


Figure 2
Sharp Vs. Blunt Needles



Who Can Cannulate?

The third difference between site rotation and buttonhole is who can cannulate. In a facility that utilizes site rotation, staff members can cannulate a patient's fistula. With the buttonhole technique, you need to have the same cannulator until the tunnel is formed. After the tunnel has been formed, then other staff may cannulate the fistula.

Knowing When to Change to Blunt Needles

The time for the transition of changing from sharp to blunt needles will vary by individual. In the Pacific Northwest, it is taking approximately 8-10 cannulations for patients who do not have diabetes and approximately 12 cannulations for patients who do (Ball, 2005b).

Three particular observed changes have been identified that indicate the change from sharp to blunt can occur.

- When dialysis needles are inserted into the skin they make a “v” cut. As the needles are placed into the same spot each time, the “v” cut gradually changes to a “u” and finally to a round hole.
- The next change is the formation of granular tissue around the exterior of the arterial site. A small ridge, similar to a pouty lip, forms on the arterial site and then encircles the buttonhole site. It is not entirely clear why this happens, but one idea is that the arterial needle is “pulling” blood out, so there may be needle movement in that direction, causing the tissue to fold outward. The venous site appears to look like dimples without granular tissue formation. The thought being that the venous needle is “pushing” blood in and therefore needle movement would be towards the skin, causing a slight depression.
- The third change is actually the change in the resistance of the needle. As there is less and less skin along with tissues and nerves within the tunnel, the needle should slide in with less and less resistance. As a matter of fact, a well-made tunnel will literally suck the needle down the track to the vessel wall and then just a small push is needed to enter the fistula.

A 5-day old arterial buttonhole site is shown in Figure 1. It is clear that two out of the three observations can be seen in this picture: the cut is no longer “v” shaped, but is more “u” shaped; and you can see granular tissue formation around buttonhole site. Even from the European literature (six sticks), this site is not yet ready for blunt needles. This actual buttonhole was ready at day 8 and the patient

was changed to blunt needles (see Figure 2) on that day.

The Buttonhole Technique

The buttonhole technique site selection should include a thorough physical assessment as described in *Improving Your AV Fistula Cannulation Skills* (Ball, 2005a), and ultimately you want to create two sites that have good (low) arterial and venous pressures, good (high) blood flow rates, and will be least likely to infiltrate. The next step is to remove the scab, using one of the previously mentioned techniques. The site then needs to be prepped using your facility-approved antimicrobial agent or solution. The insertion angle is then determined based on prior experience with the patient's buttonhole, direct discussion with the previous cannulator, or written documentation of previous cannulations. Removal of the needle from the buttonhole is the same as removal of the needle when using other cannulation techniques.

Troubleshooting

Any technique will have issues associated with it, and the buttonhole technique is no exception. With little published literature available about how to actually create the accesses for buttonholes, facilities have mostly used trial and error. As a result, this author has started a training program that includes tips and troubleshooting for successful buttonhole creation, simply called *The Buttonhole Technique*.

Oozing from Needle Sites

One of the first problems staff have identified is oozing from the needle sites during dialysis. Oozing occurs for a couple of reasons. The first would be that the tunnel is not the same diameter as the needle being used, so that when a patient is heparinized, oozing occurs around the needles. The needle should fit like a finger being inserted into a glove.

Another reason for oozing occurs when staff members do not follow the buttonhole track, but try to put

the needle in at an angle they think is appropriate. This will stretch the hole and will allow blood to seep around the needles. Another problem that this issue will create is dead-end tunnels, which can collect with blood and then become sites for possible infection.

If you have more than one originator of the buttonholes and they use slightly different angles, this will cause a cone-shaped tunnel to form instead of a tunnel with the same diameter for the entire length. This cone-shape will allow blood to seep around the needles.

Using sharp needles can cause the tunnel to be cut during the insertion process. Great care has to be taken when using sharp needles to avoid this situation. However, there will be certain situations that will always require the use of sharp needles.

The Trampoline Effect

Liz Swift, a nurse educator at one of our local dialysis facilities, has described a phenomenon that occurred at her facility. On some of the patients, the tunnel developed nicely, but when they tried to use the blunt needles to enter the blood vessel wall, it just bounced off it – boing, boing, boing, just like a trampoline. After having several more facilities note the same problem, I now refer to it as the “trampoline effect” when teaching. Excessive force with blunt needles could possibly tear tissue and that hurts the patients, so the recommendation is to use sharp needles on these individuals all the time, being careful not to cut their tracks. Using sharp needles has reduced the pain that these patients had complained of and allowed them to continue using the buttonhole technique.

Hospitalization

Because the buttonhole technique is used for home and in-center programs, acute dialysis nurses may not have knowledge of this technique. If the patient is well enough to explain how to insert the needles and the nurse is comfortable doing that, there

is usually no problem. If a nurse doesn't want to utilize a technique they are not familiar with, they can rotate sites, making sure they stay at least 3/4-inch in front of the tunnel to prevent accidentally cannulating through the tunnel wall. When the patient returns to the in-center facility, the patient care staff may need to use sharp needles until they get the buttonhole tunnel re-established, and then they can change back to blunt needles. Each patient is different, and just like with pierced earrings, some of us cannot leave our earrings out without our tunnels closing or becoming narrowed, while others never have a problem with that. The same is true with the buttonhole tunnel.

Blood Flow Problems

The buttonhole technique is just another method of inserting needles into an AV fistula. It should not cause a decrease in blood flow rates, increase in alarms, increase in machine pressures or a decrease in adequacy. A couple of problems have been identified. One patient was learning to self-cannulate and when she inserted the needle, there was a slight change in the direction of the needle. Over the course of her treatment, her pressures started rising, causing alarms and subsequently the blood pump was turned down. When I observed how she cannulated, it was apparent that by the end of the treatment, the needle was migrating back to the original angle of entry and the needle was ending up against the wall, causing her alarm condition. Once she chose a new site where her entry was straight down the fistula, she no longer had those problems.

Another problem occurs when taping the needles too tightly, forcing the needle up against the wall. The needles should be taped securely, but not tightly. Taping across the wings just stabilizes the needle from moving within the access – it is the chevron, the “v” or “u,” that prevents the needle from falling out.

Finally, if the patient experiences constant pain at a buttonhole site or you are seeing pressure problems

that you just cannot figure out, it is OK to abandon that site and find a new one.

Conclusion

Why should we offer the buttonhole technique to our patients? Through the use of some simple testing plus observation, there has been no documented aneurysm formation with this technique, which could possibly extend the life of fistulae. Without missed sticks, hematoma formation or infiltrations, there will be a reduction in hospitalizations and missed treatments associated with complications. Through many patient surveys, it has been found that the buttonhole technique is a viable technique for reducing pain of cannulation and may help those patients who have needle fears. And, finally, the buttonhole technique can promote self-cannulation and allow patients to be self-sufficient, more confident, and in control of the biggest aspect of their treatment – the access.

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ANSWER/EVALUATION FORM

The Buttonhole Technique for Arteriovenous Fistula Cannulation

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GOAL

To provide an evidence-based educational tool for nephrology nurses to enable them to perform and troubleshoot the buttonhole cannulation technique for assessing an arteriovenous fistula.

New Posttest Format

Please note that this continuing education activity does not contain multiple-choice questions. We have introduced a new type of posttest that substitutes the multiple-choice questions with an open-ended question. Simply answer the open-ended question(s) directly above the evaluation portion of the Answer/Evaluation Form and return the form, with payment, to the National Office as usual.

Evaluation

- By completing this offering, I was able to meet the stated objectives
 - Identify at least one barrier that may preclude a patient from utilizing the buttonhole technique.
 - List two patient benefits for the buttonhole technique.
 - Explain the changes that indicate readiness to switch from sharp needles to blunt needles.
- The content was current and relevant.
- This was an effective method to learn this content.
- Time required to complete reading assignment: _____ minutes.

Strongly disagree **Strongly agree**

1	2	3	4	5
1	2	3	4	5
1	2	3	4	5
1	2	3	4	5
1	2	3	4	5

I verify that I have completed this activity _____
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