

Should Buttonhole Cannulation of Arteriovenous Fistulas Be Used? Moderator Commentary

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No single topic in hemodialysis vascular access polarizes the nephrology community more than the use of buttonhole cannulation (BHC) of arteriovenous fistula (AVF). BHC (also known as constant site technique) was introduced in the United States in the mid-1970s as an alternative way to cannulate short-segment AVF, later named as the buttonhole technique (1,2). BHC evolved as a niche procedure for AVF with only a short segment suitable for cannulation, although it has been utilized in an effort to ease cannulation and reduce pain, complications, and interventions, with variable success. When contrasted against the rope ladder cannulation (RLC) or the site rotation technique (recommended as the standard of care), BHC has its strong believers and nonbelievers, often amounting to a love-hate relationship resulting in intermittent intense debates and even calls for its discontinuation (3,4). The primary reason for this cannulation conundrum is the risk of local and systemic infections attributed to BHC. However, incorrect cannulation protocol and the technique of scab removal with a blunt needle before actual cannulation are frequently to blame.

Cannulation Is the Holy Grail of AVF Success

Successful cannulation is the defining moment in the life cycle of an AVF, where “rubber meets the road.” No matter how skillful and experienced the surgeon who created the AVF was and how good the artery and veins were, if cannulation fails—owing to any of a multitude of reasons—the AVF is considered a failure! Many otherwise mature AVF fail cannulation despite good dilatation and flow, because of the depth, tortuosity, or angulation of AVF that do not allow sufficient superficial straight segment of AVF to cannulate with two large needles, on a consistent, repetitive basis. Failed AVF cannulations or miscannulations are indeed quite common in dialysis units (5). The variable level of expertise of cannulators rotating on different shifts in dialysis units heavily influences cannulation success, irrespective of the use of RLC or BHC technique. It is particularly important to consider the travails of a patient performing home hemodialysis (HHD) either self-cannulating or using assistance of a family/caregiver for cannulation of AVF four to six times a week with two needles—a daunting task by any standard. BHC is often the only avenue for these lay

operators with no previous health care experience to be able to go, and stay home, although some are able to perform RLC.

In this issue of *Kidney360*, Labriola debates that the potential risks of BHC cannulation are overestimated and cites the evidence, or lack thereof, for and against the technique (6). It is quite obvious that the evidence from a handful of small, observational, retrospective studies as well as from small randomized, controlled trials that enrolled heterogeneous populations undergoing variable cannulation procedures over two decades has only managed to provide conflicting results. Although infection risk was a repetitive theme in most studies, the technique, the operator experience, and the use of personal protective equipment were widely variable among these studies. Indeed, one study that used masks on both patients and cannulators did not show an increase in infections with BHC over a year of follow-up, pointing to the deficit in the practice of technique rather than in the technique itself (7). Further, she also cites her own unpublished experience that resulted in a reduction in infections with BHC after intense modification and reinforcement of a standardized protocol. Additionally, a satellite dialysis unit using self-cannulation with BHC was not associated with more AVF infections (8). She also points to potential benefits of BHC on long-term AVF patency and interventions, aneurysm formation, cannulation pain, and reduced bleeding after needle removal, although the flaws in the methodology of the studies taint the evidence.

In her opposing view in this very issue of *Kidney360*, MacRae contends that BHC does not offer safety or benefits over RLC standard of care (9). Additionally, the evidence that the BHC track is prone to staphylococcal colonization is problematic (10). Many studies demonstrate an increased risk of infections with BHC and a meta-analysis found the risk to be similar to or even higher than the infection risk with catheters (11). However, the meta-analysis was on the basis of studies considered rather small and poor in quality because of methodological issues, duly admitted by the authors as major limitation. Interestingly, many of the observational studies and randomized, controlled trials cited by both Labriola and MacRae are the same despite being used to make completely opposite arguments, invoking a Protagoras paradox (where the same

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argument is used by both sides to substantiate their opposite points of view). Indeed, this highlights the ambiguity of evidence and lack of conformity among the studies, making them nearly uninterpretable. Such evidence does not support abandonment of BHC, which would deprive a subset of patients on dialysis from its benefits.

More recent data on BHC has become available. A recent prospective, observational, multicenter study showed a much higher risk of bacteremia with BHC cannulation (eight-fold compared with RLC), which led to yet another call to abandon use of BHC (12,13). Additionally, data from the National Healthcare Safety Network (NHSN) from 2014 was recently published (14). This data revealed that of the 2,874,203 AVF patient-months reported to NHSN in 2014, a total of 9% (271,980 patient-months) were associated with BHC. Use of BHC was associated with 2.6-times greater risk for access-related bloodstream infection and 1.5-times greater risk for local access-site infection compared with RLC after adjusting for various facility-level factors. The number needed to harm with BHC cannulation was 370 for access-related bloodstream infection and 417 for local access-site infection. This level of risk is not only alarming, but also unacceptable related to an intended intervention of BHC. These findings have appropriately resulted in caution about use of BHC and the recent Kidney Disease Outcomes Quality Initiative (KDOQI) vascular access guidelines update (guideline 11) prefer RLC over BHC cannulation, citing moderate evidence and consider limiting the use of BHC to special circumstances on the basis of expert opinion (15). KDOQI also suggests that when BHC is performed, the use of devices to facilitate cannulation should be at the discretion and expertise of the cannulator.

Let us imagine that the BHC is abandoned on the basis of the recent data. What would happen to the patients who have been successfully using this technique without infection? Will the self-cannulating patients at home will convert to in-center dialysis to get RLC cannulation unless they are able to change the technique? What would be the fate of

those AVF that are only suitable for BHC? Will there be more catheters and AVGs in addition to unnecessary access surgeries? Will we be ignoring patient autonomy completely because of a possible risk, even in those who are willing to take that risk? Also, there may be confounding by the indication in many cases; for example, where an AVF unsuitable for RLC is, in fact, being salvaged with BHC to avoid it from being abandoned resulting in catheter use. In case of infectious complications, the patient would still have an option to fall back on an AVG. This paradigm would require utilization of a dynamic ESKD life plan, rather than using a life plan as a nonrevocable statute to continue using a particular access.

Yes, it is easy to abandon an old technique with evidence of possible harm, but it may be prudent to actually improvise and standardize it to keep the option available as a useful tool in our armamentarium for selected patients. Frankly, we have not done much, if anything, to take a fresh look at this valuable technique to provide guidance for patient selection or refine the technique, other than simply trying to prove its disadvantages through suboptimal studies. It is quite plausible that the improvement in the method of BHC creation, use of personal protective equipment (such as masks and gloves), and standardized cannulation protocol could make BHC a useful and safe alternate choice to RLC for patients, especially when the HHD population is anticipated to enter an exponential growth phase, rather than “throwing the baby out with the bathwater.”

So, what should the nephrology community do with BHC? It is clear from the discussion above that the current methods of creation, use, and maintenance of BHC are far from clear to anyone—physicians, staff, and the patients alike (16). As with every other intervention in medicine, discretion in using a device, medicine, or technique is essential. Implementing BHC use in every patient versus complete abandonment of the technique are two extremes that should be avoided. Strict selection criteria for use of buttonholes should be developed and education and

Table 1. Standardizing buttonhole cannulation: risk factors for infection and suggested strategies for mitigation

Risk Factors for Buttonhole Cannulation Infection	Possible Strategy to Mitigate the Risk Factors	Comment
Poor patient selection	Develop uniform criteria	Requires collaboration of expert workgroups
Improper technique of creation of BHC track	Can be standardized using devices instead of sharp needles	Requires research and device approval, could be expensive, although BSI reduction will save costs
Poor skin antisepsis	Develop and follow strict protocol	Requires education and auditing for consistency
Improper scab removal	Develop and follow strict protocol	Requires education and auditing for consistency
Poor cannulation technique	Need to self-cannulate or use single operator	Having single operator in a dialysis unit is logistically difficult
Post-cannulation site care	Use mupirocin topically, use correct dressing technique	Requires validation in randomized, controlled trials
Improper use of PPE	Standardize use of masks and gloves	Requires education and auditing for consistency
Nasal carriage of <i>Staphylococcus</i> in patient and operator	Consider intranasal mupirocin application	Expensive, logistically challenging

Careful patient selection, rigorous education, and frequent periodic auditing of technique will remain essential. BHC, buttonhole cannulation; BSI, blood stream infection; PPE, personal protective equipment.

training of technique should be standardized. The technique should be reviewed with an open mind in individual patient according to AVF characteristics, site and frequency of dialysis, number of operators, ease of cannulation, and patient choice. In patients with HHD, the use of BHC might be the only way to enable some patients to go home. Even for the in-center population, it may be an important method to teach self-cannulation, keeping in mind the short supply of nephrology workforce. If the patient prefers the BHC technique, it should not be denied; of course, a standard protocol should be followed. This could prove to be an important strategy in transitioning the patient to HHD in appropriate scenario.

The risk factors for infection of BHC need to be identified and mitigated (Table 1). A consistent protocol for disinfection, scab removal and dressing, and use of personal protective equipment needs to be created. A number of rather stringent cannulation protocols have been advocated by expert cannulators to achieve this highly technical task of scab removal, which can reduce the infection risk of BHC if followed religiously and consistently (17,18). Use of antibacterial ointments like mupirocin should be considered to reduce bacteremia related to staphylococcal colonization of the BHC track (19). Self-cannulation training is perhaps the only way to ensure a consistent single operator that might avoid damage to the buttonhole (BH) tract by variable cannulation that can cause adverse outcomes (20). A periodic audit of the technique will need to be included in the protocol to ensure strict adherence (21). Finally, it is important to not ignore and actively consider the patient choice and their ESKD life plan if there is a preference for HHD as the modality and BHC as the technique, with full disclosure of possible risks and benefits, as well as provision of rigorous education and training.

In conclusion, this debate highlights a significant knowledge gap in the use of cannulation techniques, especially the BHC. There is an opportunity for clinical research to investigate the outcomes of BHC and RLC techniques in more homogeneous targeted groups, such as patients on HHD with self-cannulation or those cannulated by single operators. The outcomes of patients receiving in-center hemodialysis when cannulated by one, two, or three operators versus self-cannulation should be compared after a standardized protocol is implemented. AVF cannulation techniques have remained unchanged for decades and, to date, there is no uniform, easy technique of developing BH. Devices, such as polycarbonate pegs and others, should be evaluated for creation of BH with clean margins, which would avoid repetitive injury from a sharp needle during creation. Novel methods of cannulation should also be promoted, such as use of portable ultrasound devices to assist in cannulation to reduce complications as well as the need for BHC (22,23). Use of single-needle dialysis and plastic cannula may also affect outcomes of AVF cannulation in future (24). Necessity is the mother of invention, and dialysis access cannulation is in need and ripe with opportunities for innovation.

Author Contributions

A. Agarwal conceptualized the paper, and was responsible for data curation and drafting, reviewing, and editing the manuscript.

Disclosures

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- See related debates, “Should Buttonhole Cannulation of Arteriovenous Fistulas be Used? PRO” and “Should Buttonhole Cannulation of Arteriovenous Fistulas Be Used? CON” on pages 318–321 and 322–325, respectively.