

Polar Views in Nephrology

Moderator's View: Buttonhole cannulation of arteriovenous fistulae: great caution is warranted

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ABSTRACT

Potential advantages of buttonhole (BH) cannulation over the standard rope-ladder technique have been claimed on the basis of small sized, potentially biased observational studies with a relatively short follow-up. On the contrary, randomized controlled trials (RCTs) show inconclusive or conflicting results. The uncertain benefit must thus be weighed against a definite increase in the infectious risk with the BH technique, which may not be completely abolished by preventative strategies. Awaiting the results of long-term studies (>2–3 years follow-up), the widespread use of the BH technique is not warranted, especially in busy in-centre haemodialysis (HD) settings with many rotating nurses. In our experience, the BH technique has been implemented safely in a self-care HD unit, presumably because of the limited number of cannulators and, in the case of self-cannulating patients, direct supervision by a small team of nurses. Units (and patients) willing to use the BH technique should be aware that BH is an extremely demanding technique and requires constant and strict adherence to the protocol. Regular monitoring of infection rates is recommended. Additional RCTs are clearly warranted, together with large-sized observational studies with multivariable adjustment.

Keywords: buttonhole, AV fistula, infection, cannulation

INTRODUCTION

Originally named 'constant-site' cannulation, buttonhole (BH) cannulation of native arteriovenous fistulas (AVFs), usually with blunt needles, has been recommended by the National Kidney Disease Outcomes Quality Initiative (NFK/KDOQI) [1], the United Kingdom Renal Association (www.renal.org/

[guidelines](http://www.guidelines)) and the European Vascular Access Society (www.vascularaccesssociety.com), and has been widely embraced in recent years, especially in home haemodialysis (HD) programmes. In contrast to the standard rope-ladder (RL) technique, BH cannulation sites are identical at each HD session: a tunnel track is created from the skin to the vessel by the same person, with sharp needles, along an identical angle during six to nine consecutive HD sessions. This track of scar tissue guides the blunt needles during subsequent cannulations. Importantly, as the entry site of the track heals, at least partially, between HD sessions, withdrawal of the scar tissue (scab) prior to cannulation is a laborious and critical step of the BH method and requires an extremely rigorous disinfection protocol.

Vascular access remains the Achilles' heel of HD. Ideally a cannulation technique should improve patients' quality of life, nurses' perceived difficulty in needling and AVF long-term patency. On the basis of case series and relatively small sized observational studies, several advantages of the BH over the standard RL technique have been claimed, i.e. easier cannulation, fewer missed sticks, less pain, faster haemostasis after needle removal and fewer haematomas and aneurysms [2–4]. However, subsequent reports have raised important concerns, especially by pointing to an increased risk of localized and systemic infections with BH [5–7]. In this Polar View, the PRO (Dr Nesrallah [8]) and CON (Drs Nadeau-Fredette and Johnson [9]) discussants provide together detailed, balanced and complete insights into this crucial aspect of HD practice.

OF GREATEST CONCERN: THE INCREASED RISK OF AVF INFECTION (AND DERIVED COMPLICATIONS)

The centrepiece against the use of the BH technique is the infection risk, as rightly pointed out by both the PRO and CON

discussants. Many [4–7, 10], but not all [11, 12], observational studies have indeed documented increased infection rates with BH compared with the standard RL technique. These studies differ greatly in design, population and needling procedures, making it difficult to draw firm, generalizable conclusions. Only five randomized controlled trials (RCTs) [13–17], all but one [15] including in-centre HD patients only, have been published. As pointed out by the CON discussants, three RCTs documented an increased number of local infections with BH, during 3–6 months follow-up [13–15], and in the RCTs with the longest follow-up (18 months) both local and systemic infections were increased with BH compared with RL ($P < 0.001$) [17]. Only one RCT found no difference in infection rate with BH compared with RL over 1-year follow-up [16]. However, over one-third of BH patients in this trial switched to RL. Interestingly, when our in-centre HD unit switched to BH, the rate of infection did not increase significantly until 2 years after the switch, a fact tentatively ascribed to the progressive routine with BH, and thus less attention is being given to each step of the procedure [6]. Thus, short-term RCTs may underestimate the infectious risk with BH.

Moreover, two recent systematic reviews, including RCTs and observational studies [7, 18], and the metaanalysis performed by the CON investigators, which included the three RCTs reporting infection rates [13, 16, 17], consistently found that BH cannulation is associated with an increased risk of infectious events.

A crucial and disturbing finding is the observed infection rate, up to 0.43 episodes of bacteraemia per 1000 AVF-days (summarized in [19]). This bacteraemia rate is similar to those reported with tunnelled catheters in units observing best practices in catheter care [20], and at least 4- to 5-fold higher than those reported in AVFs cannulated with the RL technique [5, 16, 21]. Needless to say, AVF-related bacteraemia, often caused by *Staphylococcus aureus*, can be associated with severe consequences, such as metastatic infections [5, 6]. Moreover, in our in-centre HD patients using the BH technique, we observed six cases of AVF haemorrhage (two fatal) over 8 years (154 728 patient-days, 0.04 haemorrhage/1000 patient-days), almost exclusively as a consequence of AVF infections [22]. Similarly, in the trial by McRae *et al.* three of the four AVF ligations that had to be performed were in the BH arm [17].

Overall, we fully agree with Nadeau-Fredette and Johnson [9] that the widespread use of the BH technique is not warranted. Any unit considering switching to BH should carefully monitor infection rates over the following years.

BEFORE DRAWING A DEFINITIVE CONCLUSION, TWO MORE QUESTIONS NEED TO BE ANSWERED AND SHOULD BE GIVEN HIGH PRIORITY

What strategy can be used to decrease the infectious risk?

A number of strategies have been proposed to decrease the infectious risk (Table 1). Perhaps the best studied is the polycarbonate peg used to create the BH track [13, 16, 23]. Interestingly, the single RCT documenting a longer AVF survival with BH used polycarbonate pegs to create BH tracks [16]. This may

Table 1. Strategies proposed to decrease the infectious risk with BH

| Strategy | Proposed mechanism of action |
|---|---|
| Sterile polycarbonate pegs | Easier creation of the BH track, avoiding multiple tracks |
| Use of face masks by both patient and cannulator | Reduction of <i>S. aureus</i> colonization of BH sites |
| Topical mupirocin ointment at BH sites | Prophylaxis of <i>S. aureus</i> colonization of the track |
| AVF arm washing and soaking scabs with saline, antibacterial soap or another disinfecting agent | Facilitation of scab removal and disinfection of BH sites |
| Application of special dressings on the BH sites | Facilitation of scab removal |
| Occasional change of BH sites in the case of bulging deformities or hypertrophic scabs | Facilitation of scab removal |
| Regular hygiene campaigns and educational workshops | Standardization of the technique and effective application of a rigorous aseptic protocol |

have reduced the creation of multiple tracks, thus lowering cannulation difficulty and resulting in fewer interventions and prolonged AVF survival. Nevertheless, the high rate of dropout in the BH arm (over one-third of BH patients switched to the RL technique) suggests some difficulty in maintaining the BH tracks. In addition, the experience with this peg device is still limited, and a possible infection risk associated with the peg device itself has been reported [13, 23]. Topical mupirocin prophylaxis applied to BH sites decreased the risk of *S. aureus* bacteraemia in a single observational study including patients receiving nocturnal home HD [5]. The Canadian Society for Nephrology accordingly recommended in 2013 its use for patients receiving intensive home HD [24]. However, the risk of resistance to mupirocin [25] might represent a substantial barrier to its long-term use. It is important to note that studies investigating the impact of measures detailed in Table 1 are few and have a short follow-up. Additionally, none of these measures has been shown as yet to completely abolish the higher infection rates observed with the BH technique. We occasionally change BH sites in the case of local infection or hypertrophic scabs that are difficult to remove, but we acknowledge that this approach is purely empirical.

Are there some settings or patient characteristics that could favour BH use?

The BH technique is often proposed to patients enrolled in home HD programmes, with the aim of improving patients' self-confidence in cannulating. However, most observational studies performed in home HD patients have documented a higher risk of infections with BH compared with RL [5, 7, 10], even in nocturnal home HD [5, 10]. Moreover, in a prospective observational study from Australia, patients on alternate-day nocturnal HD using BH had, on multivariable analysis, higher hospitalization rates for septic AVF events compared with patients on conventional in-centre HD cannulated with RL [incidence rate ratio (IRR) 3.0 (95% confidence interval 1.04–8.66); $P = 0.04$] [10]. Although home HD patients have better health status and outcomes than in-centre patients, BH

self-needling at home, without supervision by a nurse, may be a causative factor. Admittedly, there has been no RCT comparing BH with the RL technique in home HD settings or among self-cannulating patients. Interestingly, in our satellite self-care HD unit (total $n = 162$ patients), BH (1998–2012) was not associated with an increased incidence of infection when compared with RL used during the previous period (1990–1997) [12]. Importantly, in patients with at least one AVF-related infection, the probability of a second infection was statistically higher when BH was used. As patient characteristics are similar in patients receiving HD at home or in a self-care facility, the question arises why there is no apparent increased risk in our self-care unit. We suspect that the supervision of self-cannulating patients by a nurse in the self-care unit, unlike for patients dialysing at home, plays a role. Admittedly, our experience in a satellite self-care unit requires confirmation in other similar units.

WHERE DO WE GO FROM HERE? BH ONLY FOR SELECTED PATIENTS OR IS IT RATHER THE END OF BH?

As for many previous topics debated in this Polar View section of *NDT*, no firm conclusion is possible as yet. On the basis of the literature and our own experience with BH (in the in-centre and self-care units as well as in home HD patients), we believe that two key factors should be considered in order to avoid severe complications:

A strict adherence to aseptic protocols

Rigorous and constant educational campaigns focusing on hygiene protocols should be mandatory for the AVF cannulators in units using BH cannulation. Rigorous disinfection not only before, but also after scab removal is crucial. Scab removal can be difficult and must be complete in order to prevent minute scab particles from entering the blood. These critical steps should not be performed hastily. The vascular access(es) referent nurse(s) have a critical role not only in teaching BH technique and aseptic protocols, but also in performing regular supervision of the technique by the nurses or self-cannulating patients. Recently proposed methods that facilitate complete scab removal (Table 1) may help to reduce infectious events, although long-term studies exploring the real impact of these procedures are lacking.

Integrity preservation of the BH track

This is associated with the number and the personal experience of AVF cannulators. Careful attention to the angle of cannulation is crucial to avoid injury of the track, the formation of multiple tracks, which can predispose to larger scabs that are more difficult to remove, more track injury and eventually, infection. Obviously, a given angle of cannulation is expected to be more difficult to respect in units with many AVF cannulators. The role of the vascular access coordinator(s) is essential to create BH tracks. Forceful cannulation and the intermittent use of sharp needles should be avoided [1, 6].

In conclusion, BH is an extremely demanding technique and requires constant and strict adherence to the protocol. Most postulated benefits of BH remain uncertain. This must be balanced against a proven increase in the infectious risk with the BH technique, which is not completely abolished by the use of strategies facilitating some of the critical steps of the procedure. Currently, a number of questions remain on the table. Are outcomes with BH comparable to those with RL among home HD patients? Will a reduction in the infection rate result in longer AVF survival with BH? What is the actual long-term impact of refinements in the BH technique on the risk of infection, interventions on AVF and AVF survival? Long-term studies and large-sized registries (>2 years follow-up) are essential to shed light on these questions. Meanwhile, BH cannulation may not be suitable for all HD settings. We do not recommend BH implementation in busy HD units with many rotating nurses, especially those lacking a vascular access coordinator or reference nurse. Furthermore, units using the BH technique should carefully and regularly monitor infection rates over the years, and be ready to revisit the procedure as performed by the cannulators (staff nurses or patients).

Although we have had excellent outcomes with the use of BH for more than 10 years in our self-care HD patients [12] and home HD (E. Goffin, personal communication), patients self-cannulating at home must be aware of the potentially increased infectious risk.

CONFLICT OF INTEREST STATEMENT

None declared.

(See related articles by Nesrallah. Pro: Buttonhole cannulation of arteriovenous fistulae. *Nephrol Dial Transplant* 2016; 31: 520–523; Nadeau-Fredette and Johnson. Buttonhole cannulation of arteriovenous fistulae. *Nephrol Dial Transplant* 2016; 31: 525–528)

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