Accessing the Access

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In Canada and the United States, the incident use of an arteriovenous fistula is 16% and 14% and the prevalent use of fistula is 44% and 55%, respectively (1,2). The fistula is considered the vascular access of choice for patients with ESRD because of its decreased risk for complications, including infection and radiologic and surgical interventions, once the access has matured (3). However, there remain significant challenges with fistula hemodialysis access, such as high primary failure rates, hematomas, aneurysms, and patient concerns about pain with needling the fistula (4–6).

The fistula is primarily needled using one of two cannulation techniques. The rope ladder technique involves systematic insertion of needles at different sites for each hemodialysis treatment, and the buttonhole technique involves insertion of needles in exactly the same spot, at the same angle, each dialysis treatment via a fibrous tract, typically developed by a single cannulator (7). Ease of cannulation and a reduction in pain associated with cannulation have been suggested as the main benefits of the buttonhole cannulation method (8–10).

In this issue of the journal, MacRae and colleagues (11) report the results of a well designed randomized, controlled trial in which 140 patients treated with conventional hemodialysis were cannulated with the rope ladder or the buttonhole technique. The primary outcome was pain scores using a visual analog scale at 8 weeks; secondary outcomes included time to hemostasis, hematoma formation, risk for arteriovenous fistula infection, and nursing perceived difficulty in needling. Topical 5% lidocaine gel was used during weeks 1 and 8, when the pain scores were evaluated for all patients in both groups. Between these two times, patients were allowed to use their usual topical anesthetic if required.

Pain scores and hemostasis did not differ between the two cannulation groups. However, the rope ladder group had an increased risk for hematoma formation. In the buttonhole group, there was a greater nursing perceived difficulty in needling, an increased risk for localized infection, and an increased risk for *Staphylococcus aureus* bacteremia and fistula abscess formation within 12 months of study completion.

For patients being treated with conventional hemodialysis, the use of the buttonhole cannulation technique does not appear to be associated with a reduction in needling pain. The lack of difference in pain scores in this study may be partly attributed to the use of topical lidocaine in the assessment period. The original sample size calculation was based on pilot data in which a mean pain score after rope ladder needling was 3.0±1.5, approximately double the median score seen in the actual study when topical anesthetic was applied during the evaluation period. Presumably, in the pilot study either no patients or only select patients used topical anesthetics when the visual analog scale was completed, as evidenced by the higher pain scores. However, consistent with this study’s results, both Chow et al. and van Loon et al. reported that pain was actually greater in patients cannulated with buttonhole technique compared with the rope ladder technique even though the buttonhole group required less topical anesthetica when the visual analog scale was completed, as evidenced by the higher pain scores. However, consistent with this study’s results, both Chow et al. and van Loon et al. reported a reduction in pain with buttonhole cannulation (10). That study was performed in a select small group of patients and used only an experienced buttonhole cannulator to access each site, whereas MacRae and colleagues’ study did not stipulate cannulation experience after the tract was developed. The latter better reflects a “real-life” situation.

It is unclear in these studies whether maintenance of a smooth fibrous tract is jeopardized over time in some patients, thereby resulting in a lack of pain benefit. This is consistent with the increased needling difficulty experienced over time by the nurses at 4 weeks in MacRae and colleagues’ study and the increased frequency of missed cannulations in van Loon and colleagues’ study (13). Although MacRae and colleagues’ study was randomized according to cannulation technique, the experience of the cannulators assigned to each technique is unclear. If there was an unintentional selection of expert cannulators to access the buttonhole group, findings in a nonstudy setting may be even worse when tracts are exposed to a range of cannulators’ experiences and techniques. In addition, this also raises the question about the extent to which these results can be extrapolated to patients who undergo dialysis more frequently (e.g., daily or nocturnal dialysis). In such patients, maintenance of the fibrous tract may be enhanced with more frequent and consistent cannulation by the same cannulator or damaged more by repetitive pokes of varying angles and depths by different cannulators.

Despite the lack of a pain benefit, the risk for hematoma formation was reduced with the buttonhole compared with the rope ladder technique. The use of blunt needles may help prevent inadvertent vessel
puncture. These results are consistent with those of previously published studies and may contribute to a reduction in the need for endovascular interventions as reported by van Loon et al. (14). Indeed, infiltration injury contributes to significant access morbidity; Lee et al. demonstrated that needle infiltrations are associated with a mean of 2.4 diagnostic tests, surgery appointments, or interventions (15). They may also be associated with fistula thrombosis in 25% of major infiltrations (15). There may be a role for buttonhole cannulation if a fistula is prone to recurrent infiltration injury or becomes aneurysmal.

Of greatest concern is the very significant increased risk for infection that has been documented with buttonhole cannulation compared with the rope ladder technique. Unquestionably, if a fistula matures to reliable function, it should be the ideal access associated with the fewest complications, including risk for infection. In MacRae and colleagues’ study, both local and systemic infections were increased with buttonhole cannulation. This finding is consistent with those from the other randomized study by Chow et al. The rates of fistula buttonhole local infection and bacteremia reported by MacRae et al. and in other studies are 50/1000 dialysis sessions and 0.32/1000 days, respectively, very close to the rates reported with a well managed central venous catheter (16,17). Have we denigrated our “gold standard” fistula to the status of the catheter with this buttonhole cannulation technique? With a high fistula failure rate (40%) that we tolerate as a tradeoff to fistulas that can achieve reliable, uncomplicated function, what have we left as our gold standard vascular access if the fistula is sullied by buttonhole infection? Furthermore, the buttonhole-related bacteremia is often caused by S. aureus and has been associated with devastating consequences, including septic arthritis, discitis, and death (16). Although catheter-related bacteremic death is a known complication, fistula-related bacteremic death is completely unexpected and unacceptable. In one report of patients treated with nocturnal hemodialysis, the risk for bacteremia was prevented in adherent patients with the use of topical mupirocin at the buttonhole site, but the infection rate was still much higher than with rope ladder cannulation (16).

An examination of the buttonhole cannulation technique illustrates the potential opportunities for infection to occur despite the best efforts for prophylaxis. First, the cannulation site must be cleaned properly with adequate time to allow the antibacterial soap or agent to be effective. Often, hasty efforts lead to unhygienic conditions and infection risk. Next, the scab overlying the buttonhole is removed with the “non-sharp” side of a sterile needle. Although the skin and scab are natural barriers against infection, they also harbor what Labriola et al. called “scab particles which contain bacteria” (17). Such bacteria may dislodge, particularly during scab removal, and enter directly into the exposed vessel or bloodstream, increasing the risk for infection. Further, if the scab is not completely removed, colonized segments may also be introduced into the tract wall or bloodstream during needle cannulation. Some programs first soak the scab for approximately 10 minutes with water and antibacterial soap or alcohol to facilitate scab removal. Finally, when the buttonhole is difficult to cannulate, “forcing” a blunt needle or using a sharp needle may damage the fibrous tract or create small pockets that can be colonized by bacteria, further increasing the risk for infection. When all these issues are addressed with intensive education efforts, the risk for infection can be reduced but remains higher than with the rope ladder method.

Clearly, the consistency of high infection risk noted in retrospective, prospective cohort, and randomized studies must be carefully considered against the inconsistently reported benefits of reduced pain, hematomata formation, and ease of needle insertion with buttonhole cannulation. Rather than finding ways to prevent infection in those cannulating with buttonhole technique, we should consider selective use of buttonhole cannulation to the subset of patients who may truly benefit as a result of severely aneurysmal fistulas or fistulas that have been distorted and reduced to limited cannulation areas.

In conclusion, this timely study by MacRae et al. and others suggests that the use of buttonhole cannulation is unlikely to be helpful in reducing painful cannulation and is associated with an increased risk for infection. Further challenges with hematomas, fistula thrombosis, and aneurysms may reduce the life expectancy of the fistula, contributing to our ongoing catheter dependence and suboptimal fistula use. Re-evaluation and education of proper cannulation technique rather than the “quick fix” of widespread implementation of buttonhole cannulation should first address these problems. Should challenges remain after a proper continuous quality improvement evaluation and intervention, then select use of buttonhole cannulation as a needle insertion technique may be appropriate and helpful. Until more definitive information is available from longer-term randomized, controlled trials in which access survival, bacteremia, and interventions are the priority outcomes, we must hold our functioning rope ladder cannulated fistula sacred as the vascular access with the lowest complication rate.

Disclosures
None.

References

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