Editorial

Interventional Cardiology

How does the catheter size affect access site-related complications in radial percutaneous coronary intervention?

"The concept of using a smaller guiding catheter (i.e., 4- and 5-Fr) is based on the hypothesis that these catheters may further reduce access site-related complications, including radial artery occlusion."

Although 9- to 10-Fr guiding catheters were used in the early years of percutaneous coronary intervention (PCI), a 6-Fr catheter has now become standard for most PCI cases. This pursuit of miniaturization illustrates the evolution of the guiding catheter in an effort to reduce the invasiveness of angioplasty [1]. The development of the 6-Fr guiding catheter not only contributed to the reduction in access site-related complications in the groin, but also allowed the radial artery to be used as the access site for coronary intervention. Shortly after Kiemeneij and his colleagues first performed PCI via the radial route in 1992 [2], they successfully demonstrated that this approach, termed transradial coronary intervention (TRI), could reduce access site-related complications when compared with transfemoral coronary intervention [3].

Although most radial artery occlusions are clinically silent, it is important to keep the radial artery open, as it is a potential site for future access. The concept of using a smaller guiding catheter (i.e., 4- and 5-Fr) is based on the hypothesis that these catheters may further reduce access site-related complications, including radial artery occlusion. Despite the recent development of guiding catheters with smaller diameters, 6-Fr remains the standard size for TRI [4]. As documented in previous studies, radial artery occlusion occurs in 2–10% of the cases after TRI with a 6-Fr catheter [5–9]. Given this relatively low incidence of radial artery occlusions, it remains to be determined whether further downsizing can provide meaningful benefits.

To this end, several studies compared the incidence of radial artery occlusion after TRI using 5- and 6-Fr catheters. In particular, Gobeil *et al.* observed no significant differences between these two sizes (8 and 2% for 5- and 6-Fr catheters, respectively) [7]. In agreement, Dahm *et al.* did not detect significant differences in the incidences of radial artery occlusion (1.1 vs 5.9%), as well as access site complications (1.1 vs 4.8%) between TRI via 5- and 6-Fr catheters [8]. In contrast, in a more recent study, Uhlemann *et al.* used duplex ultrasonography to demonstrate a significantly lower incidence of access site complications after TRI with a 5-Fr as opposed to a 6-Fr catheter (14.4 vs 33.1%), suggesting a favorable impact of the diameter reduction [10]. In addition, the cases of radial artery occlusion also decreased by half (13.7 vs 30.5%, respectively). However, the overall incidence of radial artery occlusion in this study appears to be high when compared with those in the previous studies [5–9]. In addition, nearly half of the patients with radial artery occlusion were symptomatic. The symptoms included a painful forearm and thenar area, loss of handgrip force, and paresthesis. Although the authors stated that routine clinical radial pulse check might be inaccurate and insensitive in detecting radial artery occlusion, this high incidence of symptomatic radial occlusion could not be explained by the use of duplex ultrasound. Furthermore, with using the same technique to identify radial artery occlusion, Yokoyama *et al.* reported contradictory results [11]. The incidence of radial artery occlusion (6.3%) was within the range of previously reported values [5–9] despite the fact that they included patients undergoing TRI with larger 7-Fr catheters in addition to those with the conventional diameter of 6-Fr. It should also be noted that all the patients with radial occlusion were asymptomatic. Thus, it

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remains to be investigated whether radial pulse check alone is in fact insufficient to evaluate radial artery patency, and the incidence of symptomatic radial artery occlusion is still to be determined.

> "...no access site-related complications were observed after 4-Fr transradial coronary intervention, whereas after 6-Fr transradial coronary intervention, such complications occurred in 6% of the cases, including three instances of radial artery occlusion and two instances of bleeding."

There have been few studies evaluating the incidence of access site-related complications associated with the use of 4-Fr catheters. We recently conducted a prospective, open-label, multicenter, randomized trial that compared the frequency of radial artery occlusion after TRI that utilized 4- versus 6-Fr catheters (NAUSICA trial, ClinicalTrials.gov identifier: NCT00815997) [9]. In this study, no access site-related complications were observed after 4-Fr TRI, whereas after 6-Fr TRI, such complications occurred in 6% of the cases, including three instances of radial artery occlusion and two instances of bleeding. The study also showed that the hemostasis time was significantly shorter in the 4-Fr TRI group (by 1.4 hours). Importantly, in addition to facilitating the patient's mobility, reducing the hemostasis time also contributes towards alleviating medical staff workloads. It should also be kept in mind that prolonged periods of radial artery compression can be associated with its occlusion and delayed reflex sympathetic dystrophy.

The potential of the guiding catheter as a tool for the treatment of complex coronary lesions depends to a great extent on its compatibility with angioplasty equipment. In this regard, the current process of catheter miniaturization may not have reached the point yet where the law of diminishing returns applies. In fact, 4- and 5-Fr guiding catheters are still associated with some limitations in their compatibility with other angioplasty equipment, which may potentially lead to prolonged procedure times and excessive material consumption, especially when it comes to the treatment of complex coronary lesions [9]. The new Glidesheath Slender introducer sheath (Terumo, Tokyo, Japan) designed for transradial procedures may represent a solution that improves the balance between catheter usability and the incidence of access-site complications [12]. Thus, although the outer diameter of this new introducer sheath (2.45 mm) approaches that of a 5-Fr sheath, the preserved inner diameter of 2.22 mm allows physicians to perform TRI with a 6-Fr guiding catheter. As a result, the risk of access site-related complications remains, at least theoretically, equivalent to that of 5-Fr TRI. In this regard, Aminian *et al.* recently reported a surprisingly low incidence of radial artery occlusion (0.8%) after TRI using a 6-Fr guiding catheter in combination with the Glidesheath Slender introducer [12].

Finally, utilization of a sheathless guiding system represents another potential solution for reducing the incidence of access site-related complications after TRI with a 6-Fr catheter. However, with a sheathless system, catheter exchange becomes somewhat cumbersome because of the need for recannulating the artery over an exchange guidewire [13]. In addition, a direct introduction of a 100-cm long guiding catheter through the radial artery and manipulations associated with the treatment procedure may increase the risk of puncture site injury. Whether the use of a sheathless guiding system could reduce radial artery complications is another important issue that requires further clarification.

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