



Prediction of Stroke After Cardiac Catheterization: No Reason, No Stroke

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I know for sure that I am not the only cardiologist who has faced an emergency in which our patients have developed unexpected cerebrovascular events after coronary angiography (CAG) or percutaneous coronary intervention (PCI). In general, major complications, such as death and stroke, are uncommon during and after cardiac catheterization procedures^{1, 2)}. However, once stroke develops in the periprocedural period, patients subsequently face serious medical problems and are at higher risk of mortality even if their coronary arteries are intact or revascularization is successful. Furthermore, most of them often suffer from some kind of motor and/or sensory disorders because of neurological deficits, leading to the deterioration of their quality of life and the loss of healthy life expectancy³⁾. In such situations, multidisciplinary assistance from other medical areas, with which cardiologists are occasionally out of touch, and various social resources are needed to support the patients.

During the past two decades, the cardiac catheterization technique and its relevant devices, such as the coronary stent and endovascular imagers, have been rapidly progressing, along with the expansion of the clinical applications of cardiac catheterization. The cardiac catheterization test is now widespread in Japan, and many patients have accordingly received a fresh lease of life from advanced PCI techniques. However, major and minor complications, including contrast-induced kidney injury⁴⁾, radiation injury⁵⁾, and cholesterol embolization⁶⁾, remain to be fully overcome and have a large negative impact on patients' prognoses. Therefore, the investigation of the actual incidence

rate of cardiac catheterization-related complications in real-world clinical settings and the identification of possible risk factors of each event should definitely be informative for cardiologists to perform safer cardiac catheterization.

In this issue of the *Journal of Atherosclerosis and Thrombosis*, Tokushige and colleagues investigated the incidence of cerebrovascular complications detected by diffusion-weighted, head-focused magnetic resonance imaging (MRI) within 48 hours after CAG and determined its clinical risk factor⁷⁾. Among 61 elderly patients who underwent CAG, 6 patients (9.8%) developed asymptomatic cerebral infarction (CI); however, no symptomatic CI or cerebral hemorrhage was observed in their prospective data. Importantly, because this study was based on a small sample from a single center, the statistical power may be weak to determine the exact risk factors, which has been accepted as a limitation by the authors of that study. However, their study provides several important clinical implications with regard to the incidence of CAG-related stroke. First, prior coronary artery bypass grafting (CABG) was the sole and independent risk factor for asymptomatic CI, suggesting that the clinical characteristic reflecting an advanced atherosclerotic state within patients appears to influence the incidence of CAG-related stroke. Indeed, patients with asymptomatic CI had approximately 2-fold multi-vessel disease and 10-fold dialysis relative to patients without the event although some conventional risk factors, such as higher age (≥ 75 years) and diabetes, were less evident. Second, procedural characteristics were unexpectedly comparable between patients with and without stroke after CAG. Although this result may be, in part, attributed to the exclusion of PCI, which often needs a longer procedural time and complex devices, the complication of stroke may be unlikely to be associated with routine catheterization procedures performed by a skilled operator. Furthermore, Sirker *et al.*⁸⁾ also reported that the access site of cardiac catheterization, such as radial or femoral, was not associated with increased risk of

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stroke. Third, how does one reduce the risk of CAG-related stroke? As advanced atherosclerosis rather than catheter procedures per se seems to have a greater impact on stroke after CAG, medical care to attenuate the progression of atherosclerosis and the excess aggregation of platelets would help to reduce the risk of vascular complications. The prevalence of statin and antiplatelet therapy was relatively high and comparable between patients with and those without CAG-related stroke under baseline medication. Large-scale, prospective studies investigating whether further medication can reduce the risk of CAG-related stroke, particularly in patients with prior CABG or advanced atherosclerosis, should provide further clinical perspectives and benefits to patients who need cardiac catheterization.

As described earlier, cardiac catheterization is no longer limited to CAG and PCI. Recent progress in the relevant techniques has made it possible to repair structural heart diseases, such as atrial septal defect and aortic stenosis. Those emerging techniques require more complicated catheter procedures and operators' mastery than do usual CAG procedures. Therefore, the prevalence and severity of vascular complications may differ partly between each procedure although they would also share some concerns in common. Indeed, neurological complications due to embolization in transcatheter aortic valve implantation are relatively high⁹⁾; however, its risk factors are yet to be fully elucidated. Furthermore, the use of embolic protection devices still appears to be controversial¹⁰⁾. Thus, the further understanding of possible risk factors and technical advances are also warranted to mitigate the risk of the latest procedure-related complications, including stroke. Our challenges in the prevention of stroke will continue as long as cardiac catheterization advances.

Upon preparing this manuscript, I went back over a section of coronary arteriography in the most famous and authoritative textbook of cardiovascular medicine "*BRAUNWALD*." The literature says, "Stroke may develop from embolization of atherosclerotic debris into the cerebral circulation or embolization of clot that formed on the injection catheters, particularly in patients with prior CABG who have a diseased ascending aorta¹¹⁾." As reported by Tokushige *et al.*⁷⁾, the incidence of catheterization-related stroke is certainly associated with prior CABG, however, prior CABG appears to be just an indirect risk marker. The primary risk of stroke should largely result from patients' advanced atherosclerosis that needs intensified medical care, including procedures such as CABG.

Conflict of Interest

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