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A Commentary on Concomitant Symptomatic Coronary Disease and Carotid Artery Stenosis - The Tufts Medical Center Experience

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Despite the development of surgical outcomes, acute stroke remain a devastating complication following coronary artery bypass grafting (CABG) [1]. Coexistent CAD and carotid artery stenosis are prevalent due to their common background of systemic atherosclerosis (20%) [2]. Naylor, et al. [3,4] demonstrated that the risk of stroke associated with CABG is 3.2% in patients with asymptomatic, unilateral severe carotid stenosis, whereas these figures increase to 5.2% in those with bilateral carotid stenosis and 7% to 11.6% in those with carotid occlusion. The management of concomitant CAD and carotid artery disease has been elucidated over time. The combination of carotid endarterectomy (CEA) and CABG in the same surgical setting was introduced in the 1980s [5]. Nonetheless, the surgical management, particularly the timing and order of surgical procedures, remains varied across North America. This commentary reflects upon the Tufts Medical Center experience on the current knowledge of the prevention of perioperative stroke in patients with concurrent CAD and carotid artery disease, focusing on simultaneous CEA/CABG.

Compared to recent literature, our recent experience of the Tufts group involving 91 patients who underwent simultaneous CEA/CABG [6] was remarkable in that over multiple cohorts spanning a 30-year period, operative mortality (2.2%) and stroke incidence (2.2%) remained low. In the series, more than half of the patients (56%) required urgent operation. We classified their 30-year experience into three cohorts, including 100 patients from 1984-1994, 74 patients from 1994-1999, and 91 patients from 2006-2018. Since the second cohort, the liberal selection criteria applied, including either asymptomatic 80-99% carotid stenosis or symptomatic ipsilateral >50% carotid stenosis regardless of the degree of contralateral stenosis. At our institution, every preoperative CABG patient has carotid duplex scanning, and vascular surgery is consulted to comment on operative candidacy on those with hemodynamically significant stenosis. As a result, there were some heterogeneities in patient's profiles across three groups, such as hyperlipidemia, urgency, and the severity of carotid artery disease. Patients in the third cohort were more likely to have asymptomatic unilateral lesion (20%, 55%, 78%, <0.01) and a moderate degree of stenosis (29%, 35%, 49%, p=.06). The argument set forth by the last two cohorts was that the inclusion of asymptomatic unilateral carotid stenosis provided benefit to the patient in that the surgery was performed alongside the CABG saving the patient an additional hospitalization and a second run of general anesthesia at no higher morbidity or mortality. The liberalized indications for concomitant surgery over the period undoubtedly contributed to the differences seen in reduced stroke morbidity – nonetheless the third cohort included higher risk patients from a CABG perspective.

There are three reasonable options for management of concomitant disease [7]: (1) Combined or synchronous CEA/CABG during the same anesthetic setting, (2) Staged CEA followed by CABG, and, (3). Staged CABG followed by CEA. According to a cross-sectional study in the United States from 2004 to 2012 [8], simultaneous CEA/CABG was utilized the most frequently (68.4%), followed by staged CEA/CABG (28.0%) and reverse-staged (CABG followed by CEA or CAS) was performed in less than 1%. The reverse-staged procedure was the least favorable strategy due to the higher associated risk of stroke [9]. Gopaldas et al. [10] reported that compared to simultaneous CEA/CABG, staged procedure was associated with increased

risk of surgical morbidities including respiratory, cardiac, wound, and renal complications that led to the increased hospital charges of more than $23,000.

Surgical outcomes of simultaneous CEA/CABG have been improving. In a systematic review of 7,863 patients between 1972 and 2002, Naylor et al. [9] reported that operative mortality was 4.6% and the incidence of stroke was 4.6%. Notably, the composite outcome of death, stroke, and myocardial infarction was 11.5%. In a meta-analysis of 15,727 patients between 2005 and 2017, Giannopoulos et al. [11] reported that operative mortality was 4% and the incidence of stroke was 3%. In terms of long-term outcomes, Levy, et al. [12] reported that the 5-year and 10-year survival rates were 74 ± 5 and 62 ± 6%, respectively. Notably, freedom from neurological events for 10 years was 92 ± 4%. Overall cost to the patient and healthcare system is reduced as well. According to a Society of Thoracic Surgeons database, post-operative stroke resulted in a 10-year cost increase of 3.3 million dollars. The individual cost per patient was estimated to be around $18,423 [13].

The surgical outcomes at Tufts Medical Center was more favorable then those previously reported. However, the series is a retrospective review and is subject to selection bias and confounding. With the advent of more advanced endovascular techniques for management of multivessel disease there may be fewer high-risk patients who are undergoing CABG – these patients exist outside of the scope of our retrospective review and we cannot comment on their morbidity and mortality. Nonetheless our most recent group which consisted of higher risk patients had similar outcomes to the preceding group and supports the notion that concomitant surgery is safe to perform. Our study also emphasized the value of collaboration between the neurology, cardiology, and both vascular and cardiac surgery teams toward challenging cases. The presence of a multidisciplinary team to effect positive outcomes in complex patients is paramount.

In selected patients with combined carotid artery stenosis and coronary artery disease, it is reasonable to perform a combined operation inclusive of those with asymptomatic unilateral stenosis. This prevents a convenience to the patient and overall lower cost of the healthcare system with no increase in morbidity.

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