From the Society for Vascular Surgery

Clinical utility of carotid duplex ultrasound prior to cardiac surgery

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Objective: **Clinical utility and cost-effectiveness of carotid duplex examination prior to cardiac surgery have been questioned by the multidisciplinary committee creating the 2012 Appropriate Use Criteria for Peripheral Vascular Laboratory Testing. We report the clinical outcomes and postoperative neurologic symptoms in patients who underwent carotid duplex ultrasound prior to open heart surgery at a tertiary institution.**

Methods: **Using the combined databases from our clinical vascular laboratory and the Society of Thoracic Surgery, a retrospective analysis of all patients who underwent carotid duplex ultrasound within 13 months prior to open heart surgery from March 2005 to March 2013 was performed. The outcomes between those who underwent carotid duplex scanning (group A) and those who did not (group B) were compared.**

Results: **Among 3233 patients in the cohort who underwent cardiac surgery, 515 (15.9%) patients underwent a carotid duplex ultrasound preoperatively, and 2718 patients did not (84.1%). Among the patients who underwent carotid screening vs no screening, there was no statistically significant difference in the risk factors of cerebrovascular disease (10.9% vs 12.7%; $P = .26$), prior stroke (8.2% vs 7.2%; $P = .41$), and prior transient ischemic attack (2.9% vs 3.3%; $P = .24$). For those undergoing isolated coronary artery bypass grafting (CABG), 306 (17.8%) of 1723 patients underwent preoperative carotid duplex ultrasound. Among patients who had carotid screening prior to CABG, the incidence of carotid disease was low: 249 (81.4%) had minimal or mild stenosis (<50%); 25 (8.2%) had unilateral moderate stenosis (50%-69%); 10 (3.3%) had bilateral moderate stenosis; 9 (2.9%) had unilateral severe stenosis (70%-99%); 5 (1.6%) had contralateral moderate stenosis; 2 (0.7%) had bilateral severe stenosis; 4 (1.3%) had unilateral occluded with contralateral less than 50% stenosis, 1 (0.3%) had unilateral occluded with contralateral (70%-99%) stenosis; and 1 had bilateral occluded carotid arteries. Primary outcomes of patients who underwent isolated CABG showed no difference in the perioperative mortality (2.9% vs 4.3%; $P = .27$) and stroke (2.9% vs 2.6%; $P = .70$) between patients undergoing preoperative duplex scanning and those who did not. Primary outcomes of patients who underwent open heart surgery also showed no difference in the perioperative mortality (5.1% vs 6.9%; $P = .14$) and stroke (2.6% vs 2.4%; $P = .85$) between patients undergoing preoperative duplex scanning and those who did not. Operative intervention of severe carotid stenosis prior to isolated CABG occurred in 2 of the 17 patients (11.8%) identified who underwent carotid endarterectomy with CABG.**

Conclusions: **In this study, the correlation between preoperative duplex-documented high-grade carotid stenosis and postoperative stroke was low. Prudent use of preoperative carotid duplex ultrasound should be based on the presence of cerebrovascular symptoms and the type of open heart surgery. (J Vasc Surg 2016;63:710-4.)**

An association between carotid occlusive disease and coronary artery disease is well recognized.[1] Perioperative stroke remains a major complication of coronary artery bypass graft (CABG) surgery leading to higher mortality, prolonged hospitalization, and increased health care costs.[2,3] Routine, nonselective screening to identify patients with carotid artery disease in patients referred for CABG was deemed as a method to reduce the risk of postoperative stroke.[4] However, selective screening for patients with either an age greater than 65 years, carotid bruit, or cerebrovascular disease would have reduced the screening load by nearly 40% with negligible impact on surgical management or neurologic outcomes.[5] Thus, the 2011 American Heart Association guidelines recommended screening only in selected patients.[6,7] Furthermore, the clinical utility and cost-effectiveness of carotid duplex examination prior to cardiac surgery have been questioned by the multidisciplinary committee creating the 2012 Appropriate Use Criteria for Peripheral Vascular Laboratory Testing.[8] The objectives of this study were to determine whether preoperative carotid ultrasound would reduce postoperative neurologic symptoms of patients undergoing CABG and to analyze the clinical utility of carotid screening in patients who underwent carotid duplex ultrasound prior to CABG vs other cardiac surgery at a tertiary institution.

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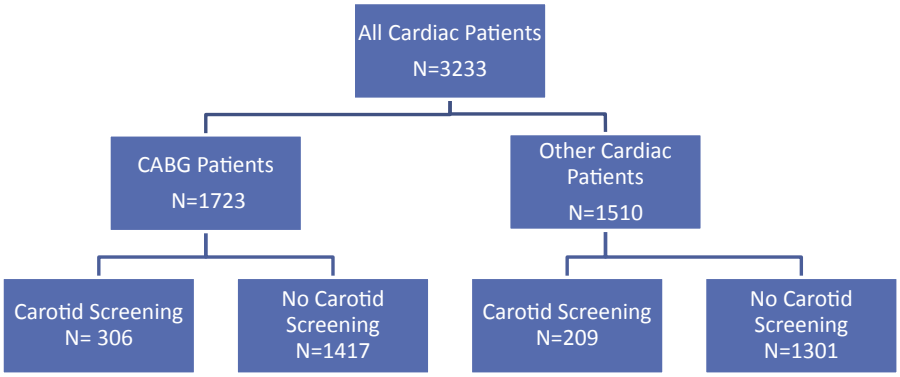

Fig. Summary of patient who underwent preoperative carotid screening.

METHODS

From March 2005 to March 2013, electronic medical records of all patients who underwent carotid duplex ultrasound within 13 months prior to open heart surgery were analyzed using the combined databases from our clinical vascular laboratory In Record Time, Inc (Fort Lauderdale, Fla) database and the Society of Thoracic Surgeons' National Database. Included patients were those who underwent CABG without concomitant valve repair. A subgroup analysis of patients who underwent other cardiac operations was also performed (Fig). Individual consents were not obtained from each patient because this was a retrospective analysis. Approval for this study was obtained from the Henry Ford Hospital Institutional Review Board.

Results of the carotid duplex ultrasound were classified as none or mild internal carotid stenosis (any type, 0%-49%), moderate internal carotid stenosis (50%-69%), severe internal carotid stenosis (70%-99%), and occluded (100%).[9,10] Carotid consensus criteria were used for the interpretation of the carotid duplex study. All carotid ultrasound studies were performed using Philips iU22 transducers (Philips Healthcare, Bothell, Wash) in a clinical vascular laboratory, which is accredited by the Intersocietal Accreditation Committee. All noninvasive studies were performed by certified technologists with Registered Vascular Technologist (RVT) credential and the results interpreted by vascular surgeons with RVT and/or Registered Physician in Vascular Interpretation (RPVI) credentials.

Preoperative, operative, and postoperative variables were retrieved from the Society of Thoracic Surgeons' National Database, which included the following variables: age, gender, weight (in kilograms), height (in centimeters), and body mass index (in kg/m^2). Comorbidities included dyslipidemia, smoking history, history of cerebrovascular accident, carotid stenosis, history of carotid surgery or stenting, family history of coronary artery disease, serum creatinine levels, diabetes, dialysis, hypertension, infective endocarditis, and chronic lung disease were analyzed. Procedure types included CABG, CABG with aortic valve repair, CABG with mitral valve repair, isolated aortic valve repair, isolated mitral valve repair, ascending or arch repair, heart transplant, and left ventricular assist device placement. Carotid endarterectomy (CEA) was performed with bovine patch angioplasty in patients undergoing CABG in a staged or concomitant fashion by discretion of the board-certified vascular surgeons.

Postoperative complications included mortality, cerebrovascular accident, and transient ischemic attack. Mortality included all deaths, regardless of cause, occurring during the hospitalization in which the operation was performed, even if after 30 days, and all deaths occurring after discharge from the hospital but before the end of the 30th postoperative day. Perioperative stroke or cerebrovascular accident was defined as any new focal or global neurologic deficit of abrupt onset caused by a disturbance in blood supply to the brain that did not resolve within 24 hours. Transient ischemic attack indicates the loss of neurological function that was abrupt in onset but with complete return of function within 24 hours.

Patient outcomes between those who underwent carotid duplex scanning (group A) and those who did not (group B) were compared. Wilcoxon rank-sum testing was used to examine binary responses such as gender. Those variables with more than two classes were examined using Kruskal-Wallis techniques. If pairwise testing was required, it was done using the Wilcoxon rank-sum test. A *P* value less than .05 was considered as evidence of significance. All statistical computations were performed using SAS 9.4 (SAS Institute, Inc, Cary, NC).

RESULTS

Among 3233 patients in this cohort who underwent cardiac surgery, 515 (15.9%) of the patients underwent a carotid duplex ultrasound preoperatively, and 2718 (84.1%) patients did not (Table I). More male patients (72.0% vs 64.8%; $P < .01$) and more patients with dyslipidemia (68.7% vs 58.4%; $P < .01$) were in the carotid screening group prior to their open heart surgery. Other comorbidities were similar between those who were and were not screened were age, body mass index, current smoker, family history of coronary artery disease, serum creatinine level, dialysis, diabetes, hypertension, infectious