Carotid Artery Stenting May Be Performed Safely in Patients With Radiation Therapy-Associated Carotid Stenosis Without Increased Restenosis or Target Lesion Revascularization: Results of a Multicenter Review

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Objectives: Neck radiation therapy (XRT) may induce carotid artery atherosclerosis and may increase the technical difficulty of endarterectomy (CEA). It is considered a relative indication for carotid angioplasty and stenting (CAS). This study sought to evaluate differences in CAS embolic potential and restenosis performed on XRT and non-XRT patients.

Methods: A total of 366 CAS procedures were performed on 321 patients (43 XRT and 323 non-XRT) at three institutions. Mean follow-up was 410 days (median, 282 days; range, 3-1920 days). Patients were followed up with duplex ultrasound imaging to assess for restenosis. Additional end points included target lesion revascularization, myocardial and cerebrovascular events, and perioperative complications. Captured particulates from embolic protection filters were analyzed using photomicroscopy and image analysis software for 27 XRT and 214 non-XRT filters.

Results: XRT patient were more likely to be male and had lower rates of hypertension, coronary artery disease, and diabetes mellitus, although the mean age at procedure did not differ (Table). There was a trend toward increased severe internal carotid tortuosity among XRT patients (XRT: 50% vs non-XRT: 34.7%; $P = .05$). Indication for CAS did not differ between the two groups, including the number of CAS performed for symptomatic carotid stenosis (XRT: 39.7% vs non-XRT: 39.0%; $P =$ not significant [NS]). Perioperative outcomes, including the composite of 30-day stroke/myocardial infarction/mortality were not significantly different (XRT: 2.6% vs non-XRT: 3.9%; $P =$ NS.) There were no significant differences in the restenosis rate at the 50% (XRT: 9.4% vs non-XRT: 8.6%; $P =$ NS) or 70% (XRT: 3.5% vs non-XRT: 8.6%; $P =$ NS) threshold. Filter particle analysis revealed that filters from XRT patients had more numerous large particles per filter and larger particles (Table). Target lesion revascularization did not differ significantly between the groups.

Conclusions: In contrast to earlier studies, this analysis reveals that there are significant differences in XRT and non-XRT patients undergoing CAS in terms of medical comorbidities, anatomy, and embolic potential. A decreased incidence of atherosclerotic risk factors was observed in XRT patients, likely because XRT was the primary factor responsible for carotid stenosis. Despite increased tortuosity and embolic particle size, CAS can be performed safely with no increased morbidity, target lesion revascularization, or restenosis in XRT patients.

Table. Demographics and particulate data (*P* values by χ^2 and *t*-test)

Variable	XRT	Non-XRT	P
Mean age, years	68.9	71.1	NS
Male, No. (%)	34 (79)	183 (56.7)	<.01
Hypertension, No. (%)	26 (63.4)	292 (90.6)	<.0001
Coronary artery disease, No. (%)	15 (36.5)	192 (59.6)	<.05
Diabetes mellitus, No. (%)	8 (19.5)	117 (36.3)	<.05
Particulate data			
Mean maximum particle size/filter, μm	1.4	0.74	<.05
Mean maximum particle size/filter, μm	1504.5	307.8	<.01

Upper Extremity Blood Pressure Differential Strongly Predicts Cerebrovascular Disease and Carotid Artery Stenosis

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Objectives: An upper extremity (UE) systolic blood pressure (SBP) differential has been reported to be a marker for systemic atherosclerosis. However, the relationship between the degree of SBP differential and the prevalence of cerebrovascular disease has not been specifically defined. The goal of this study was to analyze a large cohort of patients who underwent vascular screening tests and to determine the relationship between an UE SBP differential, clinical cerebrovascular disease, and carotid artery stenosis.

Methods: Of 3,696,778 patient screened, 241,959 did not have both UE SBP recorded, and were excluded. The remaining subjects were characterized as having no significant SBP difference (<10 mm Hg differential), mild (11-15 mm Hg), moderate (16-20 mm Hg), and severe (≥20 mm Hg) differences. Standard statistical analysis was performed.

Results: Of 3,454,819 subjects, 86.8% had no significant UE SBP differential, 9.1% (313,352) had a mild difference, 3.9% (134,278) had a moderate difference, and 0.2% (7657) had a severe difference. Increasing degrees of UE SBP differential were directly and significantly associated with increased age, tobacco use, hypertension, hypercholesterolemia, diabetes, and obesity ($P < .001$). Increasing degrees of UE SBP differential were directly and significantly associated with a history of stroke and a history of transient ischemic attack. Increasing degrees of UE SBP differential were directly and significantly associated with both moderate (≥50%) and severe (≥80%) carotid artery stenosis ($P < .001$; Fig). In multivariate analysis, an UE SBP difference of ≥15 mm Hg was an independent predictor of carotid artery stenosis (odds ratio, 1.3); a differential of >20 mm Hg nearly quadrupled the risk of having significant carotid artery disease (odds ratio, 3.9).

Conclusions: Subjects with UE SBP differentials are more likely to have traditional atherosclerotic risk factors. However, even after adjusting for these risk factors, an UE SBP difference is an independent risk factor for cerebrovascular disease. SBP differentials noted in the upper extremities can be potentially used as an excellent screening marker for the presence of extracranial cerebrovascular disease.
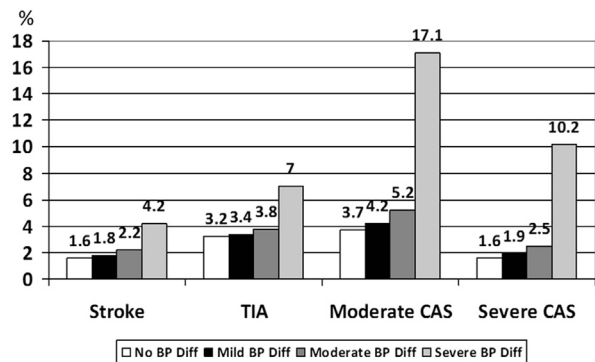
Fig. BP difference and incidence of cerebrovascular disease.

Long-Term Carotid Artery Disease Progression and Related Neurologic Events Following Carotid Endarterectomy

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Objectives: The purpose of the study was to assess predictors of long-term disease progression and clinical outcomes after carotid endarterectomy (CEA) in contemporary practice.

Methods: A consecutive cohort of CEAs between January 1, 2000, and December 31, 2010, was retrospectively analyzed. End points were restenosis ≥50% and ≥70%, contralateral carotid disease progression (50%-69%, 70%-99%, or occlusion), and stroke. Survival analysis and Cox regression models were used to assess the effect of baseline predictors.

Results: A total of 1782 CEAs (bilateral, 142; mean age, 71.4 ± 9.3 years; 56.3% male; 35.4% symptomatic, 2.7% combined with coronary artery bypass grafting) were performed during the study period with a mean clinical follow-up of 54.8 months (range, 1-155 months). Periprocedural stroke and death rates were 1.9% and 0.8%, respectively (stroke/death: overall, 2.6%; asymptomatic cohort, 1.8%). Freedom from restenosis and contralateral carotid stenosis progression is shown in the Fig, both events attaining higher rates of critical values (≥70%) after 5 years. Thirty-one (20.4%) restenosis were symptomatic (5 at ≥50%, 26 at ≥70%), and 40 (26.3%) underwent reintervention. Restenosis was predicted by hypertension (HR, 2.06; $P = .031$), female gender (HR, 1.54; $P = .012$), and younger age ≤65 years (HR, 1.64; $P = .009$). Contralateral progression was predicted by smoking (HR, 1.85; $P = .007$) and renal insufficiency (HR, 2.40; $P = .001$), resulting in carotid intervention in 27.1% of patients. No association was shown with either closure technique (primary vs patch vs eversion) or statins. Any stroke (118 events: 68 ipsilateral, 49 contralateral) rates at 5 and 10 years were 7.2% and 14.9%, respectively. Predictors were symptomatic indication (HR, 1.51; $P = .033$), renal insufficiency (HR, 1.58; $P = .046$),