

Gray Scale Median Analysis as a Tool in Selecting Patients
for Carotid Artery Stenting

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Purpose: We have previously demonstrated that the degree of internal carotid artery (ICA) plaque echolucency as determined by gray scale median (GSM) analysis is significantly related to inflammation, necrosis, disrupted or thin fibrous cap in carotid plaques removed at endarterectomy. Over the last decade, carotid artery stenting (CAS) has emerged as a viable alternative to endarterectomy in high risk patients. Unfortunately the risk of perioperative stroke from CAS has been reported from 5-11%. In so far patient selection for CAS is based solely on the severity of ICA luminal stenosis. Furthermore many patients undergoing CAS are asymptomatic. We propose that GSM analysis should be considered in conjunction with luminal stenosis to identify plaques suitable for CAS. In this study we investigated the relationship between the in vivo GSM value of hemodynamically significant ICA stenoses 50% or greater by carotid duplex ultrasound (CDU) and the presence of symptoms, patient demographics, and atherosclerosis risk factors.

Methods: CDU consecutive studies of 449 carotids with hemodynamically significant ICA stenosis $\geq 50\%$ were analyzed. Images of each ICA plaque were normalized utilizing blood (0-5) and adventitia (185-195) to determine the respective GSM value. Receiver operator characteristic (ROC) analysis was used to identify the optimal threshold GSM value which would best predict symptom status.

Results: Of 449 CDU studies with significant carotid stenosis $\geq 50\%$, 94 (21%) were excluded due to acoustic shadowing from calcification. Of the remaining 355 plaques, 46 (13%) were symptomatic. 306 (68%) were asymptomatic. The mean GSM was 51 ± 1.2 . The GSM value was significantly lower in symptomatic patients (mean 32), than in asymptomatic patients (mean 54), $P < 0.001$. ROC analysis yielded an optimal threshold GSM of 32 in predicting symptoms. In asymptomatic patients, only male sex was a predictor of a lower GSM. In symptomatic patients, none of the factors were predictive of GSM.

Conclusion: These results as well as previous studies demonstrating increased risk of embolization and stroke following CAS in ICA plaques with a GSM less than 25 indicate that GSM is a helpful tool in identifying plaque risk during CAS. Conversely ICA plaques with a high GSM or significant acoustic shadowing connoting extensive calcification are also at greater risk for disruption, fracture and release of embolic debris with angioplasty or stenting.