CAROTID EVALUATION BY REAL TIME B-MODE IMAGING, DOPPLER TECHNIQUE AND FREQUENCY ANALYSIS

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To be effective non-invasive carotid evaluation requires a selected battery of tests. Carotid disease produces anatomial change as well as pathophysiological changes at the bifurcation.

The colour coded continous wave Doppler system (Echoflow Scan Diagnostic Electronics) has been used in our neurosonological laboratory to scan over 4000 patients within 3 years. By comparison to the results of angiography the accuracy for detecting stenosis were 90 %. We found that the Echoflow scan have the following limitations:

1) with the use of only three colours to record the peak frequency, the results were occasionally ambigous.
2) when mild or moderate stenosis were present there was no way to confirm if the increased frequences were abnormal and indicative of a stenosis or increased but normal as may occur in cases with controlateral stenosis and a compensatory increase in flow
3) when the Doppler signal is weak (deep or atherosclerotic vessel) the scan results and the subjective analysis of the Doppler sounds was difficult.
4) the diagnosis of internal carotid artery occlusions was difficult to confirm in some cases and tandem lesions could not always be detected.

We felt therefore that many of the limitations of Carotid Echoflow scan would be overcome by adding a real time frequency analyzer to the Echoflow carotid Doppler scanner.
Our scanty experiences do not allow any statistional statements but we think we are able to improve the specifity to 95 %.
Although our work in this area is ongoing it became apparent that Carotid Doppler scanning using Frequency Analysis is able to

1) confirm the presence of the stenosis, the severity of a stenosis and the site of a stenosis
2) detect low velocity signals to a severe stenosis
3) diagnose tandem stenosis
4) evaluate flow pattern when the Doppler signals are attemated by a plaque.
5) distingush external and internal carotid artery
6) substantiate diagnosis of internal carotid occlusions
7) distinguish between arterial and venousflow signals

We also use in our laboratory an ultrasonic duplex scanner which provides simultaneous real time B mode vascular structures images and a single gate pulsed Doppler flow to detect velocity changes. The velocity information is evaluated using a spectrum analyzer which permits quantification of the frequency content of the reflected Doppler signal.
It is absolutely necessary to combine the real time B mode imaging system with the Doppler technique.

We examine now the ratio of peak systolic velocity in the internal carotid artery to that in its parent common carotid artery, because we felt that this ratio will be an accurate indicator of the degree of internal carotid stenosis and permit accurate categorization of most stenosis as high grade (flowreducing) or low grade (non-flow reducing lesions.

In summary we expect significant information on vascular structures and blood flow disturbances using the combination of real time B mode imaging, Doppler technique and Frequency Analysis for carotid evaluation and blood flow disturbances. In due time we hope we are able to perform a carotid endarterectomy without angiography in distinct cases.