Transcranial Doppler sonography: adding to the toolbox.

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AJNR Am J Neuroradiol 1998, 19 (4) 797-798
http://www.ajnr.org/content/19/4/797.citation

absence of these direct features, the radiologist must rely on *indirect* evidence of nodal metastases. These include nodal enlargement, three or more borderline–sized nodes in a primary drainage pathway, and a nodal morphology showing a change from an elliptical to a spherical shape.

The development of accurate radiologic criteria is important since 25% or more of patients presenting with head and neck cancer and no clinically palpable neck disease (stage N_0 necks) harbor metastatic deposits in their cervical lymph nodes. While many of these metastatic deposits may be detected by imaging,

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occult micrometastases unfortunately occur in up to 25% to 40% of radiographically normal nodes (1). Indeed, 39% of the patients with N_0 necks in van den Brekel's study harbored metastatic disease. This high incidence of clinically and radiographically "occult" neck disease has resulted in the practice of "elective" neck dissection or radiation therapy in patients with N_0 disease who are considered at high risk of nodal disease.

In their latest review of a large series of patients studied by ultrasound, the authors have found that a minimal axial diameter of 7mm in level II nodes and 6mm for the remainder of the neck represents the best compromise between sensitivity and specificity. According to their data, using these criteria, only 18% of patients who radiographically show no neck disease would harbor metastatic disease, whereas 45% of individuals with nodes that meet these criteria would not. In other words, 45% of patients with no neck disease would potentially undergo elective treatment of their neck.

Relying on indirect evidence of nodal metastases limits sensitivity and specificity and is far from ideal. Annually, a large number of patients who have no neck metastases are subjected to neck dissection or radiation therapy with the hope of treating occult nodal disease. Thus, the development of sensitive and specific radiographic criteria for the detection of metastatic lymphadenopathy assumes great importance. These same authors have espoused the technique of ultrasound-guided fine-needle aspiration for cytology, since they believe it overcomes the lower sensitivity of computed tomography, MR imaging, and ultrasound without aspiration (2) In the United States, this technique has received less acceptance because it is labor-intensive and operator-dependent.

While we will integrate these new size criteria for nodal disease in our daily practice, we would really prefer to visualize directly the actual tumor focus within a node rather than rely on indirect criteria. A prospective trial using a combination of anatomic and metabolic techniques in a group of patients who will undergo neck dissection is sorely needed to assess whether these techniques, used together or in a serial, algorithmic manner, can improve the accuracy of non-invasive detection of metastatic nodal disease. High resolution surface coil MR techniques or helical CT scanning at 1 mm increments may increase the accuracy by improving our sensitivity to nodal heterogeneity. Positron emission tomography (PET) may also improve the detection of nodal disease. Overall, in multiple studies, FDG-PET has a sensitivity of 72% to 91% and a specificity of 88% to 99% for detection of nodal disease. It is possible that new tracers under development such as [11C]-methionine or [11C]-tyrosine will improve these results, though availability of studies based on positron-emitters other than 18-fluorine are limited by the need for an on-site cyclotron. A recent review of the role of FDG-PET in head and neck cancer proposed a pre-therapy staging PET exam was most useful for clarifying equivocal results from other imaging studies and occasionally revealed disease that was not shown on CT or MR imaging (3).

Until improvement in the direct detection of nodal metaseses by imaging methods is realized, the size criteria proposed by van den Brekel et al may improve our ability to identify individuals at slightly higher risk for disease in the neck. With this information at least some patients may be spared the morbidity of elective neck dissection or radiation therapy.

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Transcranial Doppler Sonography: Adding to the Toolbox

Transcranial Doppler sonography (TCD) allows measurement of the velocity and direction of blood flow in the arteries at the level of the circle of Willis in a noninvasive, real time, and accurate manner. It is also safe and inexpensive. In this issue of the *American Journal of Neuroradiology* Kaps et al (page 758) describe TCD use in monitoring middle cerebral artery flow during thrombolytic therapy of two patients

with an acute ischemic stroke. Information obtained from TCD was applied to adjust the duration and dosage of thrombolytic therapy; perhaps another important use of this modality. TCD offers important advantages over other techniques used for the assessment of cerebrovascular hemodynamics in its speed, safety, and cost-effectiveness. Why, then, does this method remain largely outside the mainstream of the neuroradiologist's techniques? A number of factors may create this paradox.

First, TCD measurements are extremely operator-dependent. The majority of neuroradiologists do not have significant hands-on experience performing Doppler examination and thus lack the necessary skills to perform or supervise the performance of such studies. This, combined with the neuroradiologist's proclivity for anatomy over physiology combined with a non-anatomical TCD-generated data format may create a subtle but very real bias against the technique.

A second possible explanation for the neuroradiologist's underutilization of TCD relates to a temptation to extract more information from examinations than is actually present in the data. As with a variety of other diagnostic modalities, this can result in an initial enthusiasm that is soon replaced by a mistrust

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of the approach. Using currently available instruments, TCD can accurately reveal the direction and velocity of blood flow at the level of the Circle of Willis, particularly in the middle and anterior cerebral arteries. The shape of the waveform provides information that can also be used to *estimate* the state of resistance in the downstream vasculature. Since it is not possible to determine and monitor the diameter of an examined artery accurately, TCD cannot determine if elevated velocity is caused by an increased blood flow or a decreased arterial diameter. The complexities of intracranial hemodynamics significantly limit TCD. The recent development of ultrasound devices suitable for intracranial duplex examinations offers promise for considerable improvement in this shortcoming.

Because of the intimate relationship between velocity changes, vessel diameter, and accurate measurement of the direction and velocity of blood flow, TCD is most widely used either to assess the state of collateral pathways or to monitor relative changes in flow. In the latter example, relative changes in flow can be assumed to result most often from perfusion pressure variation such as may occur during test occlusion of the internal carotid artery or development of caliber changes in the large distribution arteries as in post subarachnoid hemorrhage vasospasm. Although few direct correlations exist between velocity measurements and the perfusion of downstream tissue in the above applications, considerable experience indicates the technique still provides information that, when viewed in the context of individual patients, is helpful for making management decisions. Decreases in middle cerebral artery velocities of more than 65% have been associated with evidence of significant decreases in tissue perfusion in a variety of circumstances such as in tolerance tests of internal carotid artery occlusion, carotid endarterectomy, and evaluations of patients with position-related ischemic symptoms. Such observations, though empirical, often prove to be of significant practical value. Recently, TCD's capability to detect intracranial embolic events has spurred several investigations. This ability is unique to TCD and seems a potentially valuable aid in the monitoring of many endovascular procedures.

As TCD-related technology improves, this method of investigation has great potential to increase the quality of available information regarding the dynamics of cerebrovascular circulation. This will heighten the understanding of cerebrovascular hemodynamics. Neuroradiologists should seize the opportunity to participate in the development and application of this technology.

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Anticardiolipin Antibodies and Transverse Myelopathy: Expanding Our Understanding of an Elusive Clinical Problem

One of the most difficult problems in clinical neurology involves the diagnosis and treatment of a patient presenting with an acute or recurrent transverse myelopathy. When there is an abrupt onset of motor, sensory or autonomic spinal cord dysfunction, the primary aim of initial imaging studies is to rule out compressive mass such as a hematoma, tumor, bone/disc, or infectious process. When these and other underlying lesions such as a vascular malformation or spinal cord tumor have been excluded by history or imaging findings, other causes of acute transverse myelopathy (ATM) are sought. These include collagen-vascular disorders, multiple sclerosis, infectious myelitis, or a parainfectious/paraneoplastic process. When the exact origin for the first or recurrent episodes of ATM cannot be established, the term *idiopathic acute transverse myelopathy* is applied. *Myelopathy* is preferred over *myelitis* because it is unclear if an inflammatory condition exists in these patients. In this issue of the *American Journal of Neuroradiology* Campi et al (page 778) draw our attention to the possibility that many of these idiopathic and recurrent cases may be the result of underlying thromboses created by circulating anticardiolipin antibodies.