

DUPLEX SCANNING IN RENAL AND MESENTERIC ARTERY OCCLUSIVE DISEASE

Alan M. Graham, MD, FRCSC

Evaluation and screening of mesenteric and renal artery disease has been based on clinical judgement followed by angiography. The risk, morbidity and costs associated with angiography have precluded its use as a valuable screening tool. In this issue of the Journal (pages 17 to 20), Taylor and colleagues report on the use of duplex scanning for postoperative assessment of the mesenteric and renal arteries.

The method of B-mode real-time imaging combined with Doppler evaluation (duplex scanning) has become the standard for carotid artery evaluation, and in the past decade its value has broadened to include study of lower extremity arteries and intra-abdominal vessels. There is no doubt that in experienced hands and on properly selected patients, duplex scanning can provide valuable information on the presence or absence of stenosis of the renal and mesenteric arteries and follow-up of endovascular interventions such as balloon angioplasty, with or without bypasses or placement of stents.

In the study of Taylor and colleagues, duplex scanning was used to follow up patients who had under-

gone treatment for renal or mesenteric artery disease. It is a tribute to the vascular technologists involved that all 31 vessels included in this study were successfully imaged. Successful imaging and Doppler evaluation are not always obtained. A number of conditions can prevent complete bilateral renal evaluation; scanning is time-consuming and highly operator-dependent; and nondiagnostic studies are frequent in obese patients when bowel gas obscures the vessels or when transmitted aortic pulsations or respiratory motion interfere with Doppler measurements. The presence of nonvisualized accessory renal arteries is a common cause of inaccurate evaluations. This is in contrast to the findings of Taylor and colleagues. Other recent prospective reports^{1,2} have reported failure or incomplete Doppler examinations in up to 40% of studies. More importantly, accessory renal vessels seen on angiography were virtually never seen by duplex scanning. These vessels alone can be the source of renovascular hypertension.^{1,2}

The definition of stenosis is controversial. Taylor and colleagues adopted the most widely used standard to define renal artery stenosis: the ratio of

peak systolic velocities (PSVs) measured between the renal artery and the aorta. This ratio of 3.5 or greater seems to correspond to a greater than 60% stenosis with an accuracy of 91%.³ Other standards have been defined, and these must be evaluated when comparing data from different groups. A common standard for stenosis greater than 50% is a PSV of more than 150 cm/s. Hoffmann and associates⁴ showed that renal artery PSV alone is more accurate in predicting renal artery stenosis than the renal-aortic velocity ratio. A third measure of renal blood flow is the resistive index (RI). This compares the PSV (A) with the maximum end-diastolic velocity (B) by the formula $RI = (A - B)/A \times 100\%$. This is a more helpful measurement of interlobar artery stenosis than of orificial artery stenosis. These values can then be compared from one kidney to the contralateral kidney. Schwerk and colleagues⁵ showed that the RI falls significantly with a stenosis of 70% or more. I believe that this method combined with that of Taylor and colleagues will provide additional data and are not competitive.

Evaluation of the mesenteric ves-

From the Division of Vascular Surgery, UMDNJ-Robert Wood Johnson Medical School, New Brunswick, NJ

Correspondence and reprint requests to: Dr. Alan M. Graham, Associate professor and chief, Division of Vascular Surgery, UMDNJ-Robert Wood Johnson Medical School, One Robert Wood Johnson Place, CN-19, New Brunswick NJ 08903-0019 USA

sels is even more difficult technically, and a number of studies⁶⁻¹⁰ have reported an unusually wide range of normal mesenteric artery flow velocities, ranging from 103 to 196 cm/s. Taylor and colleagues used a PSV of 275 cm/s or more for a 50% stenosis in the superior mesenteric artery and a PSV of 200 cm/s or more in the celiac artery. Before every vascular service uses this modality for screening for mesenteric ischemia, the importance of the angle of the Doppler insonation, the appropriate sample volume and the difficulty of imaging in the presence of obesity must all be clearly understood. Other factors that make imaging of these vessels difficult include the proximity of the superior mesenteric and celiac vessels to each other and the problem of a transmitted aortic pulsation. The optimal angle of insonation is 60° for the Doppler pulse. If the angle is altered by 2°, the error in the velocity will be 7%. This may explain why velocity ratios rather than absolute velocities are found to be more accurate. A further compounding effect has been reported by Jager and associates,⁶ who found that mesenteric blood flow after a meal can increase by 1.8 times over the baseline blood flow, whereas celiac artery blood flow *is not* affected by the physiologic response.

The final point to be made is the use of colour duplex scanning intraoperatively after completion of a bypass. Hansen and associates³ found an 11% rate of major defects of bypass grafts, prompting immediate repair, with the use of completion duplex scanning. Use of the B-mode image and the Doppler velocities is easier and less risky than completion angiog-

raphy and would allow comparison of these intraoperative studies with the postoperative studies that Taylor and colleagues present. This might lead to earlier detection of postoperative changes within the reconstructed vessels.

In summary, duplex scanning of the renal and mesenteric vessels is an excellent method of preoperative screening and postintervention follow-up. The important message is that the study is extremely dependent on the skill of the technician performing the study, on the angle of insonation, the sample volume measured and the body habitus and anatomy of the patient.

Controversy still arises as to the best measurement for the accurate diagnosis of stenosis: renal-aortic velocity ratios, PSVs (variable values), RIs or a combination of these in conjunction with B-mode imaging.

It is incumbent upon each vascular laboratory to assess its own accuracy against the standard of angiography, which is still the definitive diagnostic tool. With time and effort, however, duplex scanning will supplant angiography in many cases.

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