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THE USE OF COLOUR DOPPLER VASCULAR MORPHOLOGY IN IMPROVING THE ULTRASOUND DIAGNOSIS OF BREAST LESIONS

William E. Svensson

Radiology Department, Ealing Hospital NHS Trust, Uxbridge Road, Southall, Middlesex UB1 3HW, United Kingdom

High resolution real time ultrasound allows detailed visualisation of many abnormal breast masses. Though many lesions may have classical appearances probable diagnoses vary with the patient's age. Occasionally, cancers can present with mainly benign ultrasound features, particularly as patients get older when the incidence of cancer increases. The likely diagnosis of the ultrasound abnormality may be changed if the patient's age or previous history of the lesion do not fit with the proposed diagnosis. Information on the vascularity and perfusion of lesions helps in further categorising the probable diagnosis1. Initial studies showed that cancers almost always had significantly increased numbers of the vessels within them (colour Doppler positive). Benign lesions were colour Doppler negative or had minimal vascularity[2].

As Doppler systems have improved in sensitivity, more vessels in the breast have become detectable and vascular density has become a less reliable predictor of malignancy[4,5].

The vascular morphology of abnormal masses is proving to be a useful aid in prediction of malignancy. The typical position of normal vessels (along the glandular surface or running with the Cooper's ligaments) with a straight or gently curved path are helpful in their distinction from pathological vessels which tend to be numerous, tortuous and abnormally positioned. Similarly, vessel branching is a predictor in that, the greater the branching and the closer the branching, the greater the likelihood of malignancy. Comparison with the contralateral breast is helpful. The ratio and position of vessels around and in lesions are useful predictors of malignancy[6,7].

A study of 351 fibroadenomas and 117 cancers[8] has shown that Colour Doppler ultrasound vascular pattern information is more accurate than subjective vascular density in the diagnosis of breast cancers and fibroadenomas. The high resolution grey scale imaging provided by a high frequency dedicated breast probe identified almost all the cancers whilst maintaining a high degree of accuracy. Addition of vascular pattern grading improved sensitivity with only slight loss of specificity. Diagnosis of lesions less than 1 cm in diameter is also improved by analysis of vascular morphology Typically, 95% of fibroadenomas have curved marginal vessels around the periphery with relatively straight or curved vessels running into them, often along the septa which divide the lobules of lobulated fibroadenomas. The number of vessels is related to the size of the fibroadenoma and age of the patient. During pregnancy and breast feeding, fibroadenomas are usually very vascular but still have a typical fibroadenoma vascular pattern. Vessels around the periphery of 95% of cancers have a radial alignment. Any breast lesion with radial rather than marginal feeding vessels should be regarded with suspicion.

Three D ultrasound has the potential to provide greater detail of the vascularity associated with abnormal lesions. Three D images of vascularity alone are easily produced using colour Doppler acquired data but in the absence of tissue detail the exact relationship of vessels to greyscale abnormality can only, at best, be approximated. Transparent 3D blocks of greyscale information combined with colour Doppler vascular information still do not overcome the problem of difficulty in appreciating the greyscale abnormality due to the heterogeneity of echo pattern of surrounding breast tissue in most cases.

Observation of lesion to vessel relationships is improved with the use of split 3D blocks with retention of

vascularity outside the split grayscale block. If the lesion is given a transparency such that it becomes black and echo free so that it can be differentiated from the surrounding tissues when seen from within, and the block is split through the lesion,

appreciation of the vascular pattern in and on the surface of the ultrasound abnormality is easier. Giving some transparency to the surrounding tissues of the remaining tissue half block also allows appreciation of some of the vascularity outside the lesion. When this is done to both halves of the block, the vascularity, within the lesion, at the surface of the lesion and outside of the lesion, can be more accurately appreciated, giving the equivalent of an angiogram which also shows the precise position of the ultrasound abnormality. Initial review of 250 lesions[9] show that the vascular morphology is often better demonstrated using split 3D views of grey scale and vascular information than in either 2D images, 3D vascular only or transparent 3D block images. Feeding, external and internal vascularity is clearly demonstrated and enumeration of vessels in different regions around and within lesions is now possible. The combination of greyscale and vascular information permits immediate accurate assessment of the exact relationship of vessels to the lesion. The radial feeding vessels and chaotic distribution of vessels within cancers is more easily appreciated. The marginal distribution of vessels in vascular fibroadenomas allows more diagnostic certainty. Even inflammatory vascular lesions such as resolving abscesses which have a worrying grey scale appearance have a vascular morphology with features that are more typical of a benign than a malignant lesion. Intramammary lymph nodes have a very typical fan shape internal vascularity, which makes them instantly recognizable in 3D.

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