concerning the influence of gestational age on human fetal and utero–placental blood flow in the fetal aorta, umbilical artery, inferior vena cava and the arcuate artery in the placental bed. This study in human pregnancy is compared with the influence of gestational age and heart rate in ovine pregnancy. A chronic sheep preparation using atrial pacing to induce fetal tachycardia and hydrops and study the effects on the lamb fetal aortic flow velocity waveform is discussed. Pulsed Doppler ultrasound has a role to play in the management of human fetal dysrhythmias and examples of these are presented. A study is presented concerning the use of pulsed Doppler ultrasound in 41 patients with pregnancy-induced hypertension and intrauterine growth retardation. The results of this study suggest that Doppler ultrasound may prove beneficial as an adjunct to fetal monitoring in high-risk pregnancies. Doppler abnormalities appear to be a more sensitive indicator of fetal distress than the gold standards of fetal monitoring, cardiotocography and biophysical profile assessment. The place of Doppler ultrasound as a screening tool in obstetrics and the possibilities of using colour Doppler flow mapping as another method of fetal monitoring in high-risk pregnancies are addressed.

Physics, instrumentation and bioeffects

Chairmen: J. A. Evans and A. J. Hall

Colour flow imaging, by B. A. J. Angelsen. Abstract not received

The enhancement of cavitational effects by acoustic pulsing and by a relative rotation of the sample and the beam, by T. G. Leighton

The search for free-radical production in the ultrasonic beam produced by duplex ultrasound systems, by D. C. Crawford, A. J. Walton, A. Mortimer, M. Dyson and L. D. Allan

Wound healing acceleration by ultrasound, by A. R. Hosseinpour, R. Hickman, S. R. Young and M. Dyson

Absence of sonoluminescence in the human cheek, by M. J. W. Pickworth, T. G. Leighton, J. Tudor and P. P. Dendy

The potential of seismic migration for medical ultrasound image enhancement, by W. A. Sandham and J. L. Bowie

Determining the motion characteristics of tissue-mimicking phantoms from ultrasound B-scans, by A. Brasher, D. K. Nassiri and A. E. A. Joseph

Systems for evaluating the clinical potential of speckle suppression and parametric imaging, by J. C. Bamber, J. V. Phelps, G. Cook-Martin and C. R. Hill

The application of knowledge-based techniques to the interpretation of ultrasound images, by A. S. Morton, G. Winstanley and R. J. Burwood

A large-capacity, low-cost image archiving system using a personal computer and optical disk, by A. Parkin, H. M. Norwood and A. J. Hall

Recent developments in the NPL ultrasound beam calibrator, by A. Shaw and R. C. Preston

The enhancement of cavitational effects by acoustic pulsing and by a relative rotation of the sample and the beam

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When sound cavitates a liquid, sonoluminescence can occur. This luminescence originates from the reaction of free radicals created within collapsing bubbles. Thus the production of sonoluminescence indicates the presence of free radicals, and therefore the potential for biological damage. Previous workers have increased biological damage and chemical effects due to ultrasound by acoustic pulsing (Hill et al, 1969) and by rotating biological samples in an ultrasound beam (Church & Miller, 1983). Sonoluminescence has also been enhanced by pulsing (Pickworth et al, 1988) and by rotating (Leighton et al, 1988) a therapeutic ultrasound beam. In both the pulsing and the rotating acoustic regimes, bubbles that were originally non-oscillating are forced into oscillation. Computer plots show that before the steady-state motion is reached, transients in the function can cause the minimum bubble volume attained in an oscillation to be greatly reduced, consequently increasing the maximum temperature and pressure generated within the bubble. This would enhance the free-radical production, and so increase the likelihood of biological damage. It is proposed that this transient excitation of bubbles contributes to the effects outlined above. This theory is supported experimentally by the detection of short-lived flashes of sonoluminescence at the start of continuous-wave insonation, and at the beginning of each pulse during pulsing. High-speed photography can also be used to verify the predictions of the computer plots.

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