

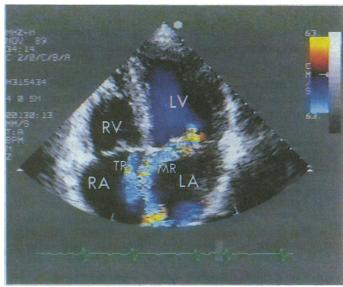
Colour Doppler flow mapping

A new dimension for cardiac diagnosis

The technique of spectral Doppler ultrasonography has greatly improved non-invasive cardiac diagnosis in recent years, particularly in the quantitative assessment of valve stenosis.¹⁵ Colour Doppler flow mapping heralds yet another important advance in cardiac ultrasound imaging.⁶⁸ It provides an immediate, real time moving image that shows the direction and velocity of blood flow within the heart in relation to surrounding structural information provided by two dimensional echocardiography. Technically, colour flow mapping is a multigate pulsed Doppler system that displays spatial flow information superimposed on a portion of the two dimensional echo image. Flow towards the transducer is generally encoded as red and flow away from it as blue; the intensity of the colour increases as the velocity of blood flow rises, and the result is, in effect, an ultrasonic angiogram.

Colour flow mapping has had its greatest impact in congenital heart disease, where its ability to display often complex relations of flow and structure is of paramount importance. It can rapidly and accurately localise the site of a ventricular septal defect and identify multiple defects and estimate their size more accurately than is possible using echocardiography alone,⁹ and it has rapidly become established as an important diagnostic technique throughout the range of simple and complex congenital heart lesions.

The apparent similarity to angiography meant that colour Doppler flow mapping was also quickly promoted as potentially an accurate non-invasive method for measuring regurgitation through heart valves by mapping the size of the regurgitant jet.^{7 8 10-12} This initial enthusiasm has recently been tempered, however, by research showing that the colour imaging of regurgitant jets by Doppler flow mapping depends much more on the velocity or driving pressure of the regurgitation than on its volume,¹³⁻¹⁵ though it may still be possible, for example, to categorise mitral regurgitation as mild, moderate, or severe in some cases.¹⁶ Nevertheless, colour flow mapping is clearly the most sensitive method yet available for detecting the presence of regurgitation through heart valves. Indeed, as a result of colour flow mapping it has become apparent that as many as 90% of normal people have tricuspid and pulmonary valve regurgitation and 30% have evidence of mitral regurgitation.¹⁷ This form of "physiological" regurgitation is not apparent clinically, neither is it of any haemodynamic importance, but it has altered our concepts of normal valve function. The clinical place of colour Doppler flow mapping in adult cardiology remains to be fully established, but it has proved particularly useful for rapidly distin-



Colour Doppler flow map image in a patient with mitral regurgitation (MR) and tricuspid regurgitation (TR). MR jet is initially directed towards interatrial septum and swirls down septum and around back of left atrium. RV = right ventricle, LV = left ventricle, RA = right atrium, LA = left atrium

guishing mitral regurgitation from a ventricular septal defect in patients after an infarct, for identifying the presence of valve regurgitation, and in guiding the sampling site of continuous and pulsed wave spectral Doppler ultrasonography. It is also valuable for assessing the function of prosthetic valves, especially when used with transoesophageal echocardiography.¹⁸

Though subject to many of the physical limitations of ultrasound imaging, colour Doppler flow mapping provides us with an accurate method of looking at spatial information about the velocity of blood flow within the heart. We need now to assess its ability to provide accurate, quantitative, and clinically useful information—as well as the cost benefit aspects of the technique. Already, however, it is clear that colour Doppler flow mapping is able substantially to improve our understanding of flow physiology in the normal and diseased heart.¹⁹ It is being seen as one of the most important advances in cardiac ultrasonography since the development of two dimensional echocardiography.

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Prophylactic antibiotics and caesarean section

Important role but not necessarily always

In Britain, as elsewhere, the caesarean section rate has increased, and in the face of pressures from litigation it is unlikely to decline.1 Postoperative infection is an important complication, causing immediate and chronic abdominal pain, impairing fertility, and, in severe cases, threatening the mother's life. Antibiotic prophylaxis during caesarean section has been subjected to many controlled trials² but has not found widespread favour in Britain,³⁴ though it is used more extensively in the United States.²⁵

The National Perinatal Epidemiology Unit in Oxford has recently carried out a meta-analysis of the randomised controlled trials of the value of antibiotic prophylaxis at the time of caesarean section.² No fewer than 16 000 patients were included, and wound infection was usually defined as either a positive bacterial culture or the presence of frank pus.⁶ In the groups given placebo or no treatment the mean incidence of this was 9%, corresponding to that of 6-14% in a recent national study.4 Although more difficult to measure, other indicators of postoperative infection include postoperative febrile illness7 and endomyometritis,8 and the meta-analysis found average rates in untreated mothers of 40% and 26% respectively. Serious postoperative infections, such as pelvic abscess and septicaemia, were less common but still developed in an appreciable number of patients.

In contrast to these figures, mothers who had received antibiotic prophylaxis had infection rates of about one third of those in the untreated controls. This proportionate reduction occurred for all the outcome measures studied in the meta-analysis, with the confidence intervals showing high significance. These results point strongly to the conclusion that antibiotic prophylaxis should be considered in caesarean section.

What the meta-analysis does less precisely, however, is to say how policies should be developed for individual mothers. It is not yet certain whether antibiotic prophylaxis should be given to all mothers having caesarean sections or to those at greatest risk.⁵ Several factors—such as the duration of labour⁸ and prolonged rupture of the membranes9-carry an increased risk of postoperative infection so that mothers having an emergency caesarean section may gain more than those having an elective procedure.⁵¹⁰ Other important factors are the timing and route of giving antibiotics,⁵ for a central principle of prophylaxis is that peak tissue concentrations should be achieved when the bacteraemia is highest." Nevertheless, systemic administration of the antibiotic can be delayed until after the cord has been clamped without loss of efficacy.¹² This policy, now the one most widely adopted, avoids any antibiotic reaching the neonate. Local administration of antibiotic has been tried but has little to offer over intravenous injection during surgery.5 Possibly multiple doses will be more effective than single ones, although multiple doses will be more complex to arrange, more costly, and more likely to cause side effects.13 The results of comparative studies suggest that broad spectrum penicillins and cephalosporins are equally effective,⁸ and that adding metronidazole will not increase their potency.25

No harm should result from any prophylactic regimen, and the most immediate risk is anaphylaxis: two deaths have occurred with antibiotic prophylaxis after operations (not caesarean sections).¹⁴ Provided there is no history of allergy the risk of such tragedies is low and has to be balanced against that of death from preventable infection after caesarean section.² Another concern is the development of resistant strains of organisms in maternity hospitals,^{10 15} an important argument in limiting the use of prophylactic antibiotics.³ If antibiotic prophylaxis becomes more widespread we shall need to monitor mothers who develop infection despite prophylaxis for resistant strains as well as the patterns of resistance among the hospital flora at regular intervals.¹⁰

The Oxford group, however, has taken the argument a stage further, suggesting that prophylactic antibiotics at the time of caesarean section would be cost effective.¹⁶ They argue that the cost of prophylactic antibiotics would be more than compensated by savings in staff time, inpatient stay, and the cost of therapeutic antibiotics. Several similar hypothetical analyses of the costs of hospital acquired infection have been put forward,¹⁷⁻¹⁹ and the Oxford group's hypothesis must be tested prospectively in a controlled trial. The major cost of hospital infection is prolonged hospital stay and even the most careful case-control study leaves the possibility that the infection and the prolonged stay both result from other factors in the patient's condition. For example, in a prospective study of gynaecological surgery cephradine prophylaxis for abdominal hysterectomy reduced costs to the hospital and the community health services with measurable improvement in the patients' rate of recovery.²⁰ Nevertheless, there was no significant difference in length of hospital stay between the groups given prophylaxis or placebo. Moreover, the same study found that prophylaxis for vaginal hysterectomy did not reduce hospital stay or improve the recovery rate, despite